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To AUTHORS: Articles covering not more than ten printed pages of the JOURNAL are preferred. However, when space permits longer articles will be used, though they may have to wait their turn longer. Those submitted by members of the association will also naturally be given preference as to time of appearance, though studies from non-members are not only welcome but solicited and will, of course, be preferred where obviously superior. For it must remain the policy of the JOURNAL and ASSOCIATION to foster everything that will advance the field, and be in the best interest of those whose speech, voice or hearing need our services.

Scientific studies, including those dealing with therapy or treatment procedures, have from the beginning been the type solicited, and those accompanied by objective evidence will always be given preference over the purely discursive or empirical.

Articles submitted from abroad will be published in French, German, Italian or Spanish—the language of the author. But they must be presented as good clear typewritten copy, for it takes too long to return proof to such authors for correction and the printer must be considered since he has to set type letter by letter.

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A QUALITATIVE ANALYSIS OF EYE-MOVEMENTS DURING STUTTERING

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Acknowledgment

To Professor Lee Edward Travis who suggested this study, and to Professor Travis and Dr. Robert Y. Walker who directed it to completion, I wish to express my appreciation.

I. Introduction.

The object of this study was to see whether stutterers differ from normal speakers in eye-movements during both silence and speaking. It continued the research begun by Jasper (1), Murray (4), and Jasper and Murray (2). Those studies indicated the adaptability of the eye photography technique to a better understanding of the stuttering act.

The visual apparatus offers a direct approach to both the general and specific stability of an organism. If the extent and the types of disintegration during stuttering are important, it is hoped that the present study offers a still further contribution to the understanding of this speech disorder.

II. Apparatus and Procedure.

All records were photographed with the Iowa Eye Movement Camera (3) to which was added an additional lense for recording head movements. Briefly, this camera permits simultaneous binocular photography of both horizontal and vertical eye-movements and of head movements. A shield was placed a short distance from the film box so that by a simple movement all of the beams of light could be interrupted simultaneously in order to mark homologous parts of a record. A signal light was arranged to shine on the edges of the film in order to designate stuttering spasms.

Every effort was made to secure the intelligent co-operation of all subjects. The apparatus was explained and the exact procedure outlined. Four records were taken in the following order:

A. Silent Fixation. The subject was asked to fixate a dot printed on the stimulus paper. It was hoped that this would furnish a situation common to all subjects that would eliminate the stuttering factor, thereby furnishing a basis for comparing records of speech with those of stuttering.

B. Silent Reading. In this situation, the subjects read silently a selection of moderate difficulty taken from the reading material used by Walker (5). This situation was one step above the previous one in

complexity, since it added the burden of silent reading with its attending eye-movement integrations.

C. Oral Reading. In this situation, the subject was asked to read orally another selection of moderate difficulty taken from Walker. This situation added the next step in difficulty since vocalization and articulation were included.

D. Fixation During Propositional Speech. In this situation, the subject was asked to fixate the same dot used in the first situation during propositional speech. He was instructed to fixate continuously, to speak directly to the dot about anything that came to his mind. It was suggested that he give his name, home state, and to talk about anything of interest to him. In addition to this, the stutterer was asked to produce those sounds and words which gave him the most difficulty. By having the subject speak directly to the dot, it was hoped that a communicative situation might be obtained.

III. Subjects.

Fifty-two adult stutterers, five female and forty-seven male, and fifty-six normal speakers, seven female, and forty-nine male served in this study. Most of the stutterers were in attendance at the speech clinic and the remainder were those applying at the clinic for examination. All degrees of severity were represented in the stuttering group. The normal group of fifty-six were largely graduate students enrolled in the departments of Psychology and Speech. Several members of the faculty and a number of undergraduates in the above departments were also used. It was noted that in both conversation and during their speech in the experiment, certain normals had distinctly hesitant speech and a few of the same had articulatory difficulties. Whereupon, members of the faculty well acquainted with the speech proficiency and speech history of these cases recommended separating from the normal group a certain number of borderline cases. These cases will be treated separately later in the study.

IV. Results and Discussion.

A. Silent Fixation. This situation did not reveal any significant differences between stutterers and normal speakers.

B. Silent Reading. In harmony with the findings of Murray (4) we found stutterers to have more fixations per line, wider variation in the duration of fixation, and more regressions than normal speakers. The records of the borderline group were similar to those of the stutterers

C. Oral Reading. During those parts of the record where the stutterer enjoyed free speech, his records were quite similar to those of the normal speaker during speech. Differences appeared to be associated mainly with stuttering spasms and speech hesitancies. The following were noted during speech disturbances: (1) a larger number of fixations per line; (2) more variation in duration of fixation; (3) greatly prolonged duration of fixation; (4) regressions; (5) alternate movement to the right and left; (6) slow continuous horizontal movement; (7) marked movement of the head with little or no compensatory movement of the eyes; (8) closing and blinking of one or both eyes; (9) an increase in the extent of horizontal tremors of the head

and eyes; (10) periods of rigid fixation; (11) general chaotic incoordination. The most of these phenomena were reported by Jasper and Murray (2).

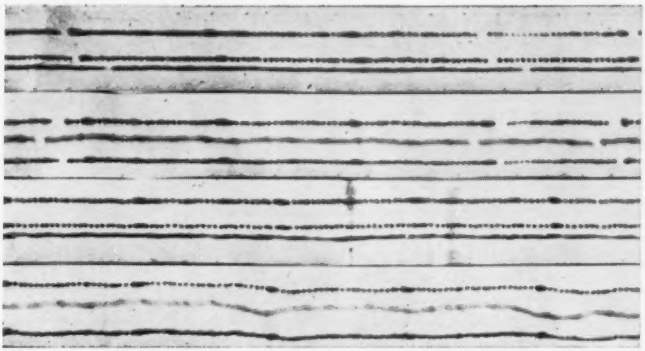

Fig. 1. A record of a normal speaker. The first two films are of silent fixation, the lower two of propositional speech. In this and in all subsequent records the vertical film showing horizontal movement is placed immediately above the horizontal film showing vertical movement. The continuous line is the headline.

D. Fixation During Propositional Speech. Sixty-four per cent of the normals and no stutterer fixated continuously during the records of propositional speech (Fig. 1). For those individuals who were unable to fixate continuously the eyes moved to the right, left, or both for varying lengths of time (Fig. 2). In some cases these lateral

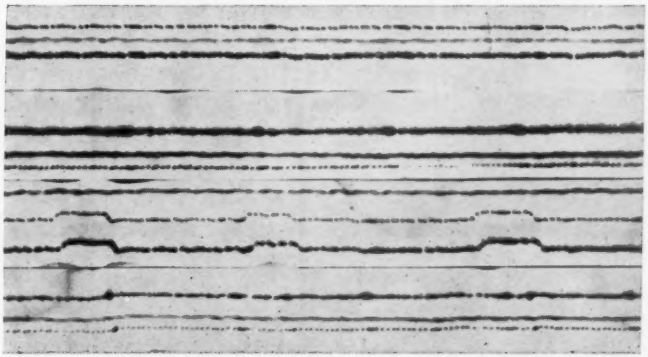

Fig. 2. Records of silent fixation and fixation during propositional speech of a stutterer. The propositional speech record shows three movements of the eyes to the right for periods of .24, .20, and .26 sec. respectively. Subject stuttered continuously.

movements were occasional, but with some stutterers they occurred so frequently that it was impossible to determine when the eyes were fixating the dot (Fig. 3). The majority of the normal individuals who were unable to fixate continuously were the borderline speech

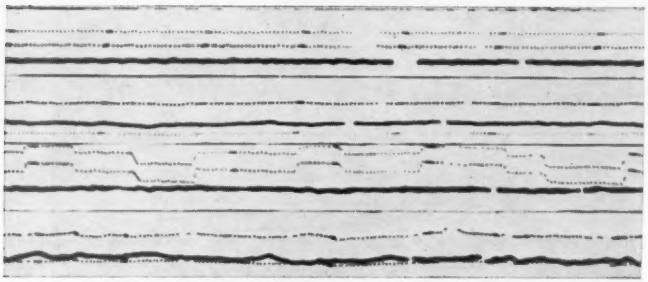

Fig. 3. Records of silent fixation and fixation during propositional speech of a stutterer. During propositional speech the eyes move from the original fixation to the right, back, to the left, back, to the right, back, to the right, back, to the left, and back. Subject stuttered continuously.

defectives. These lateral movements occurred most frequently during stuttering spasms, although they occurred occasionally immediately before and after such spasms. Less frequently, they occurred when no speech difficulty was observable.

A classification of the horizontal movements and the percentage of cases in which they occurred are given below.

1. Movement to the right (Fig. 2): normals 14 per cent; borderline cases 100 per cent; stutterers 83 per cent.

2. Movement to the left: normals 7 per cent; borderline cases 7 per cent; stutterers 79 per cent.

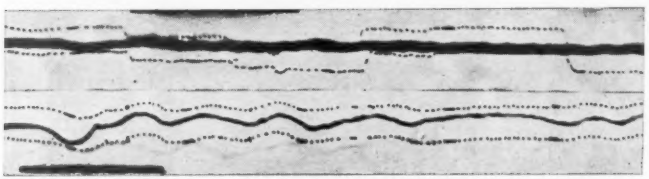

Fig. 4. Fixation during propositional speech record of a stutterer. The top film shows progressive movements to the left, the lower film shows vertical head movement with little or no compensatory movement of the eyes.

3. Movements to the right and left (Fig. 3): normals 7 per cent; borderline cases 7 per cent; stutterers 62 per cent.

4. Movements to the right, left, or both: normals 14 per cent; borderline cases 100 per cent; stutterers 100 per cent.

5. Movements to the right or left in progression (Figs. 4, 5).

These movements resembled the saccadic movements of reading. Most frequently the eyes moved to the right or left and then moved farther out in the same direction before returning to the original fixation. Less frequently the eyes moved in one direction and then reversed to the opposite side before returning. These saccadic movements occurred in 44 per cent of the stutterers.

6. Movement to the left and upward (Fig. 5). These occurred in 15 per cent of the stutterers.

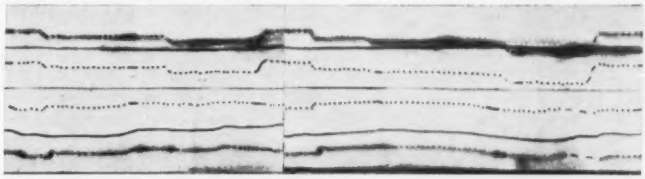

Fig. 5. Fixation during propositional speech record of a stutterer. The top film shows progressive movements to the left. The lower film shows that as the eyes move to the left they also move upward.

7. Movement to the right and downward (Fig. 6). This occurred in 12 per cent of the stutterers.

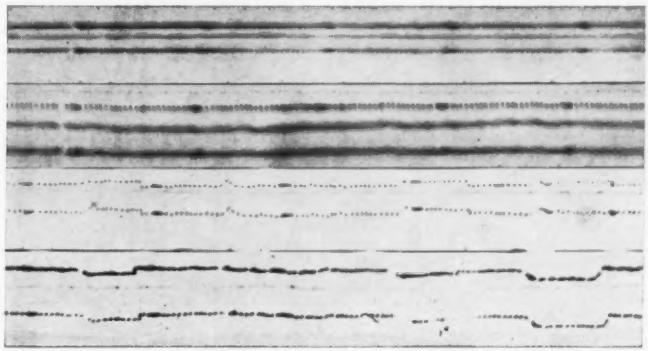

Fig. 6. A record of silent fixation and of fixation during propositional speech of a stutterer. The lower two films shows movement to the right and downward. Subject stuttered continuously.

8. Increase in extent of horizontal tremors (Fig. 7). In practically all records of stutterers and normals there occurred frequently a slight horizontal tremor of about ten cycles per second. This was exhibited in the head and eyes alike. During stuttering spasms there was often a marked increase in the amplitude of this tremor.

It appeared gradually in some cases and abruptly in others. This was noted in 67 per cent of the stutterers and 9 per cent of the normals.

All of these differences reported are statistically significant.

Marked vertical movements of the head with little or no compensatory movement of the eyes (Fig. 4), slow continuous horizontal movements of the eyes (Fig. 8), periods of rigid fixation, and periods of general chaotic disturbances occurred to various extents during stuttering.

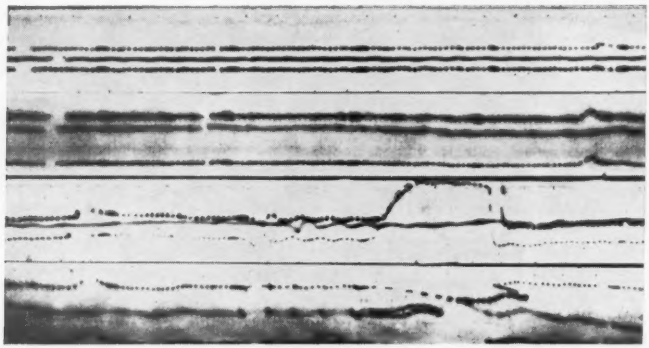

Fig. 7. A record of silent fixation and of fixation during propositional speech of a stutterer. The record of propositional speech shows a blink, an increase in the amplitude of the horizontal tremor of the head and eyes followed by a movement of the eyes to the right. Subject experienced difficulty in speaking.

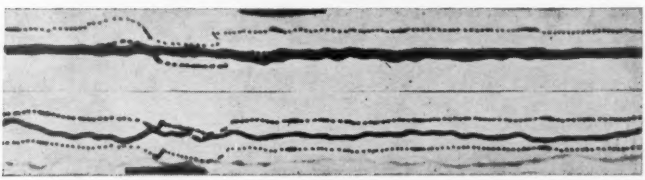

Fig. 8. Record of fixation during propositional speech of a stutterer. The eyes move to the right and then make a slow continuous movement further to the right and back to the left.

As far as this study goes, it appears that stutterers do not differ from normal speakers when they are not concerned with speech. During silent fixation, the two groups did not differ. Since no new discoveries were made in reading, no discussion will be given. The records of fixation during propositional speech are of special significance. In general, it may be said that normal speakers fixate continuously upon the dot during propositional speech. The records here were almost identical to those during silent fixation, differing only in slight nodding movements characteristic of overt speech.

The lack of ability of the stutterers and borderline normal cases to fixate the dot during speech and stuttering expresses itself, as seen in the data, in several ways; all of which, however, may be summarized under lateral movement, right, left, or both. This would indicate, certainly, that the so-called stuttering spasm extends beyond that mechanism commonly accepted as a speech mechanism. Along with a lack of concise and ordinarily voluntary control of the speech muscles during stuttering, there appears to be a similar lack of control in regard to the muscles of the eyes.

The question arises whether the more or less random and purposeless movements of the eyes during stuttering are mainly further manifestations of the stutterer's attempts to do something about his stuttering spasm, or whether they are a part of the symptom-complex itself. That is, when the stutterer has a spasm and finds himself in its grip, he may use certain parts of his organism in unusual ways in an attempt to release himself from the grip of the stuttering spasm. Or it may be that his eyes are making the purposeless movements reported in spite of anything the stutterer may be able to do about it.

The question reduces itself to this: Are the eye-movement abnormalities voluntary or involuntary? Some light is thrown on the question by the introspective reports from the stutterers. The majority of them stated that they were unaware that they were not fixating the dot during stuttering spasms. One of our normals, especially recommended for speech proficiency, stuttered during the first part of his propositional speaking in the experiment. During this period lateral eye-movements were detected by direct observation. He quickly gained control of his speech and no more disturbances were noted in the course of a long record. As soon as the camera stopped he volunteered that he had stuttered for the first time in his life. However, he was unaware of any movements off the dot. Examination of his record (Fig. 9) verified our observations. Some stutterers after examining their records to be sure that they did make such movements, promised the experimenter to refrain from doing so the next time. They were unable to keep this promise. Of course, this does not answer the question fully, since these eye-movement abnormalities might have become deeply ingrained reaction habits. However, since in daily life there is no point in attempting, during a spasm, to fixate a point, it is doubtful if they could have been established as habits. There is no reason to suspect that they are due to fatigue or fluctuation-in-attention factors. Rather it seems that they are in some way related to the stuttering act and appear to be due to a generalized inability to manipulate the speech mechanism as well as the eyes, unless it is to be argued that the stutterer possibly moved his eyes from the dot, as we have said before, in order to break a spasm. This latter interpretation is denied by the stutterers' introspective reports. Thus, it would appear that these random eye-movements during stuttering are an integral part of a symptom-complex of stuttering itself, showing the extent to which the stuttering spasms grip the whole organism.

In general, it would appear that this study supports the concept that stuttering may be a generalized neuro-muscular derangement. The eyes may be thought of as a functional mid-line lever unit. Under normal circumstances they function as such. Fixation of the eye is a result of equilibrium between muscles controlled by centers on either side of the brain. Considering then, that these centers working individually may function in reaction patterns of opposite motor orientation, they must be mobilized some way in order to produce and maintain smooth and efficient fixation. If such a mobilization is not forthcoming, the two sides may compete for control of the eyes and the eye-movement disturbances found in this study during stuttering may constitute still further peripheral symptoms of stuttering. Thus

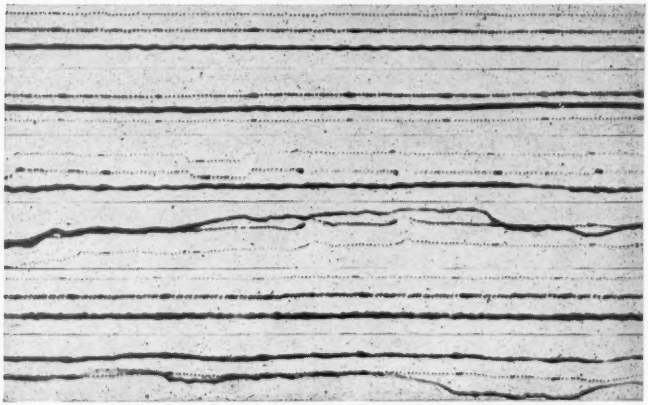

Fig. 9. Records of a normal speaker. First two films are of silent fixation. Next two films are from that section in which Subject reported stuttering for the first time. Lower films are from the period following when he spoke normally.

the lateral movements of the eyes might be thought of as the result of fluctuation of dominance from one side to the other or the lack of it. Progressive saccadic movements to the right or to the left, as the case may be, may be indicative of an increase of this dominance.

The anatomical proximity with certain interconnections between Broca's areas, the associate centers for conjugate movements of the eyes, and the centers for the motor projection areas suggests the possibility of an upset of eye control with any lack, shift, or variation of motor speech dominance. It may be, too, that rivalry between the eye centers themselves, exclusive of speech conflicts, may account for certain disabilities in silent reading.

V. Summary and Conclusions.

A photographic study of the eye-movements of 52 stutterers and 56 normal speakers during silent fixation, silent reading, oral reading, and fixation during propositional speech indicated the following conclusions:

1. During silent fixation there are no significant differences.
2. During silent reading stutterers tend to have more fixations per line, wider variation in duration of fixation, and more regressions.
3. During oral reading differences are associated mainly with stuttering spasms.
4. In fixation during propositional speech differences associated mainly with stuttering spasms are: a variety of lateral movements; an increase in extent of tremor in the head and eyes; marked vertical movements of the head with little or no compensatory movement of the eyes; periods of rigid fixation; and periods of general chaotic disturbances.

This study indicated that along with stuttering there appears to be a similar lack of control of the muscles of the eyes. It supports the concept that stuttering may be a generalized neuro-muscular derangement and may account for certain reading disabilities.

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The tentative program for the annual convention of the A. S. C. A. and joint meetings with the N. A. T. S. appears on pages 159-162. The complete and final program will be published in the December issue of the Journal.

REVIEWS

By CHARLES H. VOELKER
Director, Dartmouth College Speech Clinic

CLASS LESSONS FOR IMPROVING SPEECH. By E. COTREL and E. M. HALSTEAD. Boston: Expression Company, pp. 101, 1936, $1.00.

"This textbook is a response to the request of many classroom teachers for a simple non-technical book for general speech improvement, a book that does not aim to correct such severe speech disorders as stammering, stuttering, lisping and lateral substitutions, but one that can be used by the classroom teacher for the improvement of the speech of all her pupils. The material has been chosen and arranged so that it may be clearly understood and the directions easily carried out by those teachers who have had no special training in the science of normal speech, or the technical subject of phonetics. The only equipment required is a small mirror for each child. The lessons have been planned primarily for children of fourth, fifth and sixth grades, but may be adapted to both younger and older children. Allowing at least one week for each lesson, the material could scarcely be completed under two school years." Bibliography. Index.

THE DEVELOPMENT OF LINGUISTIC SKILL IN TWINS, SINGELTONS WITH SIBLINGS, AND ONLY CHILDREN FROM AGE FIVE TO TEN YEARS. By E. A. DAVIS. Minneappolis: University of Minnesota Press, pp. 165, 1937, $2.00.

The University of Minnesota Institute of Child Welfare began its studies on ontogenetic phonetics with McCarthy's study, "Language Development in the Preschool Child," considering children from one and a half to five years. A study by Day followed, covering the same ages but giving special attention to language retardation in twins. This third study considering the next age group gives attention to articulation in addition to the other factors. Linguistic retardation in twins was found to persist to nine and a half years, growing continuously less marked and being more concerned with articulation than diction and content. Only children progress continuously. The study of 436 children showed that the more intelligent are linguistically superior to the less intelligent, the upper socio-economic group is superior to the lower, and girls are superior to boys. Some of the chapters are: *Articulation, Length of Sentence, Complexity ond Accuracy of Sentence Structure, Frequency, Function, and Length of the Different Words Used*, and *Types of Twins and Resemblances Between Twin Pairs*. 79 tables, 163 references, index.

(*Continued on page* 184)

POSITION AS A FACTOR OF ATTENTIONAL CLEARNESS IN RELATION TO STUTTERING*

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Kansas City, Missouri

I. Introduction.

The significance of sidedness in relation to nervous organization and bilateral functions has long been appreciated (4, 8, 16, 17, 18, 23, 27, 28, 29, 30, 32, 35, 39). The present study was planned to investigate the possibility of developing a test for the determination of "native" sidedness, of such validity as to permit accurate individual diagnosis. Such a test is especially needed in the examination of stutterers (21, 34, 35, 36).

A series of experiments (5, 6, 11, 12, 13, 15, 19, 24, 41) by Dallenbach and his associates has established the importance of position in the visual field in relation to attentional clearness. Certain of these experiments (6, 13, 41) discriminated between right and left handed observers on the basis of perceptual differences in clearness of stimuli, depending on the position of the stimuli in the visual field. The left visual field seemed to have preferential perceptual clearness for the right handed observers, the right visual field for the left handed observers. A physical basis for these experimental conclusions was suggested by the investigation of Cohn and Papez (9) who reported that of 100 human brains examined the great majority showed a predominance of development of the visuo-sensory cortical area in the right cerebral hemisphere. Studies by Anderson and Crosland (1, 2, 3) show a favoring of the left visual field by right eyed or right handed *S*s and a favoring of the right visual field by *S*s who were left eyed or left handed.

For purposes of comparison and evaluation of the Dallenbach technique each *S* took the following tests: sighting (two); ocular convergence strength; speed in mirror tracing of a star; the Van Riper critical-angle board test of laterality.

II. The Experimental Groups.

Type of subjects needed. For the development of a test to be used for clinical diagnosis with stutterers it was necessary to employ naïve *S*s because the great majority of clinical cases are of this type.

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*This is a part of the University of Iowa Speech Clinic research program on stuttering, under the direction of Professor Lee Edward Travis.

This study was carried out with the assistance of the Coe Research Fund of the University of Maine.

Individuals of very definite laterality were needed, to determine whether or not the test would differentiate between them. To the two groups thus formed was added a group of ambidextrous persons, to determine if the test would give a quantitative measure of sidedness, and also a group of stutterers. There were 20 *S*s in each of the four groups.

Method of Selection. The right, left and ambidextrous groups were selected on the basis of the latest Iowa speech clinic laterality index, which were given to students in classes, in small informal groups, or to individuals personally. In each case careful instructions were given. Each person was asked to keep the questionnaire several days until certain of the accuracy of the answers given. In case of final uncertainty on any question that question was to remain unanswered. In each case the questionnaires of individuals selected for *S*s were rechecked with *E* for possible errors.

The questionnaires were scored in terms of a dextrality quotient by means of the well known formula $D.Q. = \frac{R + \frac{1}{2}E}{N} \cdot 100$, in which R is the number of right responses, E the number of responses indicated as right or left, or right and left, and N the total number of responses. The resulting D.Q. represents the percentage of right handedness of an individual. If D.Q. = zero, all responses are left; if D.Q. = 100 all responses are right. The three groups chosen from the scores on the questionnaire were selected as follows: right handed, 98–100 inclusive; left handed, 0–35 inclusive; ambidextrous, 36–97 inclusive. In the ambidextrous group the end limits were avoided.

The group of stutterers was selected without regard for laterality, although they later answered the laterality questionnaire.

All *S*s were of college level or above. Most of them were students, a few, employees, of the University of Maine. The age range was from 18 to 45, with only two above 28.

III. Apparatus and Procedure.

Dallenbach, Position vs. Intensity

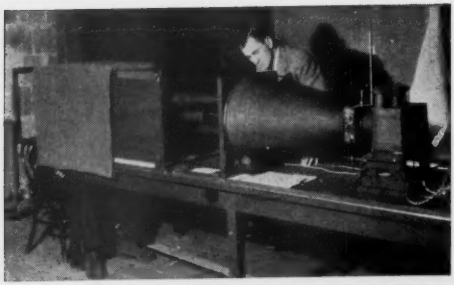
Apparatus. The apparatus used was for the most part built to meet the description of a similar apparatus used by Dallenbach (14). It was designed to test the importance of position, in terms of intensity, in the determination of attributive clearness. Dallenbach's description of the apparatus is complete, so the description here is concerned chiefly with the points of difference between his apparatus and that used in the present experiment.[1]

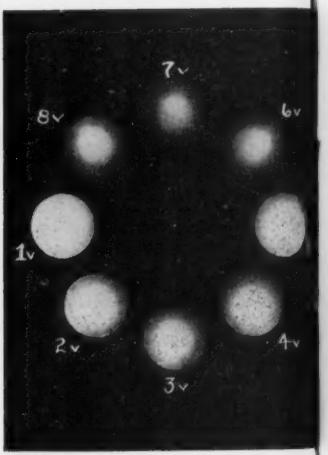
[1]Gratitude is due to Dr. Robert Y. Walker, now of the State University of Ohio, for his part in the construction of the apparatus.

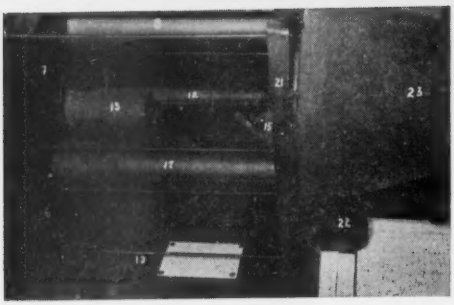
Several pictures and a schematic diagram of the apparatus are included in Figs. 1–6. Fig. 2 shows a complete view of the apparatus with an *S* in position in the light-proof booth. In Fig. 5, *S* is shown holding the biting board. Two screws supported by brackets (1 and 4) make possible a vertical adjustment of the board, and clamps (2 and 3) allow for side-to-side adjustments. *S* is placed so that the extension of the fixation point, one meter distant, falls midway between his eyes. Double cross-hairs, five in. apart, and adjusted so that they are in line of extension of the fixation point, are used to secure alignment. These cross-hairs can be seen in the picture, one set clean cut. The other (the one nearer the camera) is shown superimposed on the first set as a rather wide blue.

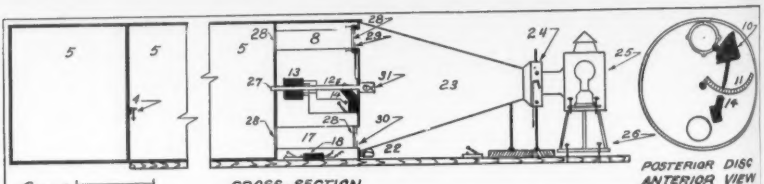
The essential part of the apparatus is the diffusion chamber. Supported in a solid frame, two discs (7 and 20), connected by two tubes (8 and 17), rotate on an axle (12). The light of two 100 watt bulbs in a projection lantern (25) travels through these two tubes to be seen by the *S*. The opening of each end of each tube is covered with ground glass (28). The openings in the disc (7) as seen by *S* are 8 cm. in diameter and centered on opposite sides 14 cm. away from the fixation point. The fixation point (27), about 2 mm. in diameter, backed by a pane of ground glass (Dallenbach's was 1 mm. in diameter), is in the center of the axle, the light coming from a small bulb (1.8 volt) in a housing (31) on the end of the axle nearest the projection lantern, the source of power being a dry-cell battery (18). The light travelling through one tube (17) is on constant intensity. The intensity is 30 per cent of its possible full intensity. This intensity is regulated by a shutter (30) in the end of the tube nearest the projection lantern. (In Dallenbach's experiments the intensity of the standard was 16 per cent.) The other tube (8) is constructed to allow for a controlled variation of the intensity of light transmitted. Supported by a framework (9), a large iris diaphragm (29) is built into the end of the tube nearest the projection lantern. This diaphragm allows a variation of intensity from 5 to 100 per cent. Gearings (10) and a scale (11) make it possible to accurately regulate the diaphragm. The opening in the diaphragm is calibrated with the scale to give the desired range of percents of intensity. (Dallenbach used a series of shutters in lieu of the iris diaphragm). A small light in a slitted cover (14), power by batteries (13), lights the scale during an experiment.

A double switch (19) controls the fixation light and the projection lantern on one side and on the other side a small, carefully-shaded lamp (22) used for recording results. A funnel (23) guides the light from the projection lantern to the near end of the diffusion chamber. The projection lantern (25) is mounted on an adjustable platform (26). The projection lantern is so adjusted that the light falls evenly over the entire inner surface of the disc (20) nearest the lantern. To secure as complete diffusion as possible the interior of the funnel and each of the tubes is enameled white. Between the funnel and the




7v
8v
6v
1v
2v
4v
3v




SCALE 30cm.
CROSS-SECTION
POSTERIOR DISC
ANTERIOR VIEW

FIGS. 1-6

projection lantern is a focal plane shutter, to control the time of the exposure of the lighted areas. The time of exposure is .1 sec. (Dallenbach used an adaptation of Wundt's gravity tachistoscope).

Figure 6 was taken with the camera lens facing the fixation point, at a distance of about 110 cm. Eight successive exposures were taken with the position of the diffusion chamber changed between each exposure. The figure is included to show the eight exposure positions used in the experiment. The numbers (1v to 8v) indicate the position of the area whose intensity is varied.

It was deemed desirable to know what retinal angles were subtended by the stimulation areas. These angles were calculated and the results are shown in Fig. 7. The distance from eyeball center to

FIG. 7

FIG. 7. Horizontal cross-section of the eyes showing the retinal areas stimulated by the stimulation sources in positions 1v or 5v while *S* is fixating the fixation point. A = area stimulated by right disc, B = macula lutea, C = area stimulated by left disc, D = line of fixation.

eyeball center was taken as 6.5 cm., and the transverse diameter of the eyeball was taken as 2 cm. Using these dimensions it was found that for the right eye the right disc (in its widest horizontal dimension) fell from 5° 40′ to 10° 15′ and the left disc fell from 5° 42′ to 10° 9′. (The positions and angles are reversed for the left eye). If the radius of the macula lutea is taken as 3° 30′ it will be seen that the inner edges of the disc fall approximately equal distances on either side, with their centers presumably in line with the center of the

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EXPLANATION OF FIGURES 1–6

Figs. 1–6. Pictures of the apparatus built after Dallenbach together with a schematic diagram. 1, 2, 3 and 4 = supports and clamps of the biting board, 5 = the light-proof booth, 6 and 21 = frames of the diffusion chamber, 7 and 20 = rotating discs, 8 and 17 = light-conveying tubes of diffusion chamber, 9 = support of iris diaphragm, 10 and 11 = gearing and scale, calibrated with iris diaphragm, 12 = axle, 13 and 18 = batteries, 14, 15 and 16 = operating light, 19 = control switch, 22 = recording light, 23 = funnel from projector to diffusion chamber, 24 = focal plane shutter, 25 and 26 = projector and its support, 27 = fixation light, 28 = ground glass screens, 29 = iris diaphragm, 30 = shutter, 31 = fixation light source. 1v to 8v = positions of the variable.

fovea centralis. It should be borne in mind in consideration of this experiment and like experiments that the positions of the images of the discs will vary in relation to the macula as the two variables vary with different *S*s and that the centers of the discs are in line with the center of the fovea centralis only in the horizontal position (positions 1v and 5v of the experiment) because the eye is drawn from its straight-ahead position by 1° 51′ for observation of the fixation point.

Procedure. The instructions given to the *S*s were the same as those given by Dallenbach: (6, 13).

> At the signal "Ready" fixate the spot of light before you; at "Now" two areas of light will be shown; report which, if either, is the more clear. Give the position of the clearer as "right," "left," or "above," "below," whichever the case may be; if they are equally clear say "same"; if you are uncertain, report "doubtful."

Experiments reported as "doubtful" were immediately repeated. The instructions were necessarily elaborated in many cases, for inexperienced *S*s were used.

Our procedure differed from Dallenbach in two respects. First, the method of limits was used. Second, each *S* was tested until he became consistent. A very few, therefore, were tested only twice. Another was tested fourteen times. The other *S*s ranged between these limits.

In no case were *S*s tested with less than one week between experiments. During each experimental period and from period to period the stimuli were presented in chance order as regards position.

Miles ABC Vision Test

This test has been described by Miles (25). The standardized V-scope and cards were used and the instructions with the test were followed in detail.

Adapted Hole-in-Card Sighting Test

This test was devised to make sighting quite difficult, as contrasted with the Miles ABC vision test. *S*, 10 ft. from *E*, sighted at the right eye of *E* through a 1.5 mm. hole in a black card, and an 8 mm. loop in a small black-insulated wire. The card was held at arm's length by the *S*. The loop of wire was suspended in the line of vision 2 feet from *E*. *S* sighted three times by holding the card in both hands in front of his body, and then slowly raising the card into his line of vision. He then sighted 3 times holding the card in his preferred hand (as shown by the laterality questionnaire), extended at his side and then slowly bringing the card into his field of vision. He then sighted in a similar manner with the card in his other hand. In all cases the card was held at arm's length. At all times *S* kept both eyes open.

Convergence Strength

S fixated a pencil point held two ft. from his eyes. The pencil was moved slowly toward a point midway between his eyes until the fixation was broken or one or both eyes moved outward. There were 5 trials. The eye to shift most or first was considered the non-preferred eye.

Star Tracing

A conventional board, screen and mirror were used for this test, with a single-line six pointed star for tracing. Each *S* was given the following instructions:

> Stay on the line as well as you can. Hit all corners. Go as fast as you can. Begin at the cross and follow the direction of the arrow. Ready. Go.

In all cases the pencil was placed at the starting point with *S*'s vision shielded. The non-preferred hand (according to the laterality questionnaire) made the first tracing. There were three trials, with at least one day between different trials. The hand making the better performance was considered the dominant one in this test.

Van Riper Critical-angle Board

The apparatus for this test was identical with that described by Van Riper (37, 38) and the technique of procedure was as nearly as possible like that used in standardizing the test (38), with one exception. Instead of carrying the test one angle beyond the critical angle of mirroring, the test was carried to the ultimate angle.

IV. Results.

Method of Scoring

General formula. In his study of tests of native sidedness Jasper (21) made the criticism that it was difficult to compare the different tests because of the lack of a common method of scoring. This criticism is valid in connection with other studies, but Johnson and Duke (22) have applied a method of scoring to different tests of laterality to make direct comparisons possible. The tests are scored in terms of a dextrality quotient after the manner of scoring the laterality index questionnaire described above.

Dallenbach, position vs. intensity. Our purpose in this experiment is quite different from that of Dallenbach. He sought an objective measure of the part played by position in attributive clearness. Accepting his findings that position is a positive factor in attention, and following the lead indicated by his experiments that the position in the visual field favored for attentional clearness is related to sidedness or laterality, it becomes our task to determine whether or not for naive *S*s this approach to a selection of positional preference will differentiate individuals on the basis of laterality, and whether or not such a technique can be used for diagnostic prediction of native sidedness. It is clear that objective measure of the *degree* of preference

for a position or positions is not necessary for our purpose. We need to know which positions are preferred as against the positions not preferred. If it should be established that for *S*s such as ours certain positions are consistently preferred by, let us say, right handed individuals, then the degree of preference or an objective measure as used by Dallenbach would conceivably serve as a criterion of the *degree* of right handedness. First, however, positional preference

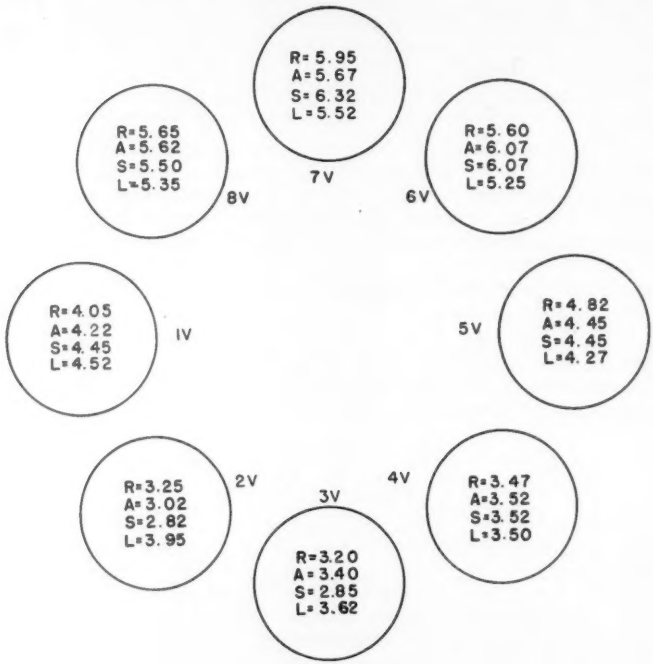

FIG. 8

FIG. 8. Averages of the four experimental groups in terms of position preference for each of the eight positions of the variable.

must be established for *S*s such as ours. Therefore, we have recorded our results in terms of positional preference. The position preferred above all others is scored 1. The position showing least attentional advantage is scored 8, with the others ranging in between. If applied to Dallenbach's findings in his first experiment of this type (13) this method of scoring would for his observer D give the following: position 1v, 2; 2v, 1; 3v, 6; 4v, 5; 5v, 7; 6v, 8; 7v, 3; and 8v, 4.

In Fig. 8 the averages of the groups are given in terms of position preference. For the left handed group, for instance, position 4v possessed the greatest attentional advantage. That is, for the left handed group, on the average, position 4v required less intensity of illumination than any other position to be judged equally clear to the position opposite it. In like manner it can be seen that for the right handed group position 3v was the most preferred position, for the ambidextrous group position 2v, and for the group of stutterers position 2v. In view of previous studies it is noteworthy that in terms of *group* preference the right handed are separated from the left handed, and the ambidextrous group and the stutterers fall together. There is great variability within each of these groups, as shown by Table I. Dallenbach's (13) right handed *S*s preferred positions 7v, 8v, 1v, and 2v. From Table I it will be seen that these

TABLE I

NUMBER OF OBSERVERS FOR WHOM THE POSITIONS OF THE VARIABLE INDICATED IN THE LEFT HAND COLUMN POSSESSED ATTENTIONAL ADVANTAGE AGAINST THE REMAINING FOUR POSITIONS

Positions Preferred	Right	Ambidextrous	Stutterers	Left
1v, 2v, 3v*, 4v	8	9	7	4
2v, 3v*, 4v, 5v	4	2	7	5
3v, 4v*, 5v, 6v	2	3	1	3
4v, 5v, 6v, 7v*	2		1	1
5v, 6v, 7v, 8v*		2		1
6v, 7v, 8v*, 1v	1	2	1	2
7v, 8v*, 1v, 2v	3		1	2
8v, 1v, 2v*, 3v			2	2
1v, 2v*, 4v, 5v		1		
2v*, 3v, 5v, 8v		1		

*Indicates the single position possessing the greatest average attentional advantage.

positions in the visual field possessed attentional advantage for 3 right handed *S*s, 1 stutterer and 2 left handed *S*s. For the left handed *S* of Burke and Dallenbach (6) the preferential positions were 2v, 4v, 5v, and 6v. In the present experiment these positions were preferred by the following: 2 right handed, 3 ambidextrous, 1 stutterer, and 3 left handed. There are some responses which are exactly comparable to the findings of Dallenbach but in the main the responses are contradictory.

It is apparent from a consideration of Fig. 8 and Table I that the determination of attentional advantage of positions in the visual field by the method here used will not serve as a diagnostic test of native laterality because of the great amount of overlapping within the groups. However, to compare these results with those from the other tests of this study the responses have been translated into dextrality quotients.[2] Positions 3v and 7v were excluded because

[2]I am indebted to Wendell Johnson and Claude Buxton for the method of procedure here.

they are neither right nor left. For scoring, attentional advantage of positions in the right visual field (positions 4v, 5v, and 6v) was considered as the normal response of right sided individuals. The position possessing greatest attentional advantage was given 3 points, the position of second preference 2 points, and the position of third preference 1 point. In the case of equal preference of two or more positions the points involved were equally divided among the positions concerned. The total number of points was 6. Then, for example, if position 4v was the preferred position it received 3 points, position 2v next 2 points, and position 1v next 1 point, the dextrality quotient would be

$$\text{D. Q.} = \frac{\text{R}}{\text{N}} = \frac{3}{6} = 50.$$

The selection of the right visual field as the normal response of right sided *S*s was purely arbitrary. If the left visual field is the normally favored area for right sided individuals the D. Q.s will be just as selective but in negative order. This is actually what happened in the averages as will be seen later.

Miles ABC vision test. In this test there are 10 trials or performances. If, for example, *S* sighted 5 times with the left eye the dextrality quotient would be

$$\text{D. Q.} = \frac{\text{R}}{\text{N}} = \frac{5}{10} = 50.$$

Adapted hole-in-card sighting test. This test has 9 trials for each *S*. In scoring, if an individual had sighted 3 times with the left eye and 6 times with the right the dextrality quotient would be

$$\text{D. Q.} = \frac{\text{R}}{\text{N}} = \frac{6}{9} = 67.$$

Convergence strength. There are 5 trials in the test of convergence strength. If an *S* should show dominance of the left eye in 2 trials, of the right eye in 1 trial and of neither eye in 2 trials the dextrality quotient would be

$$\text{D. Q.} = \frac{\text{R}}{\text{N}} = \frac{\text{R} + \frac{1}{2}\text{A}}{\text{N}} = \frac{1 + 1}{5} = 40.$$

Star tracing[3]. This test was scored from the standpoint of speed only. The total time in seconds for the six tracings of the three trials is taken as N of the D. Q. formula and the total time of the three tracings of the right hand taken as R for the formula. The obtained quotient is subtracted from 100 because the lowest score in terms of time of tracing indicates the better performance. If the total time of the

[3]The application of the D. Q. formula to star tracing and to the Van Riper critical-angle board was developed by Wendell Johnson.

three tracings for the left hand were 200 sec. and for the right hand 300 sec. the dextrality quotient would be

$$\text{D. Q.} = 100 - \frac{\text{R}}{\text{N}} = 100 - \left(\frac{300}{500}\right) = 100 - 60 = 40.$$

Van Riper critical-angle board. The basis of scoring here is taken as the correct drawing of a pattern or the correct writing of the script. Each correct achievement is given one point. Since there are three parts to the test, and since there are 10 angles in each part, and at each angle it is possible for two correct achievements to be made, it follows that in terms of the D. Q. formula there is a possible maximum N of 60, and a possible maximum R of 30. Patterns or script partially mirrored receive .5 each since a partially mirrored pattern is thereby a partially correct achievement. The method of scoring then is this: a correct achievement receives 1.0, a partial achievement receives .5, and a complete failure at correct achievement (*i. e.*, a fully mirrored pattern or script) receives .0. If, for example, an individual should have no mirrored kinaesthetic patterns in the first five positions and should mirror with the left hand in the last five positions and should have the same performance with the visual pattern and script then for each part of the test his R would be 10 and his N, 15 or the total D. Q. would be

$$\text{D. Q.} = \frac{\text{R}}{\text{N}} = \frac{10 + 10 + 10}{15 + 15 + 15} = \frac{30}{45} = 67.$$

It will be seen that this method of scoring respects the critical angle just as much as does Van Riper's method of scoring in terms of the degree of the angle as a single score, since the early or late appearance of the critical angle is the conditioning factor in the resulting D. Q. The policy of continuing the test beyond the critical angle to the ultimate angle would be invalid if changes or confusion resulted in the later angles but such has not proved to be the case. It is believed that the essential values of Van Riper's test have been retained and that at the same time it is possible with the D. Q. scores to make direct comparisons with other laterality tests.

Interrelation of the Tests

The tests were intercorrelated in an attempt to arrive at an indication of their validity and to determine the extent to which they were testing a common factor. The 80 scores of each test were correlated with the 80 scores of every other test.

Correlation of the scores for the different tests. The coefficients of correlation are shown in Table II. Few are statistically significant. However, with the exception of Dallenbach position *vs.* intensity, all correlations are positive. The two highest correlations are those of Miles ABC vision test and convergence strength with the adapted hole-in-card sighting test. The next highest correlations are between

the adapted hole-in-card sighting test and the laterality index, and the convergence strength test and the laterality index questionnaire.

TABLE II

CORRELATION OF THE TOTAL SCORES OF EACH OF THE TESTS WITH EVERY OTHER TEST

(N = 80 in all cases)

	1	2	3	4	5	6	7
1. Dallenbach, position *vs.* intensity		—.07	—.07	.03	—.06	—.21	—.14
2. Laterality index questionnaire			.25	.42	.39	.14	.30
3. Miles ABC vision test				.55	.31	.23	.13
4. Adapted hole-in-card sighting test					.50	.10	.06
5. Convergence strength						.04	.16
6. Star tracing							.02
7. Van Riper critical-angle board							

CONSIDERATION OF THE SCORES OF THE DIFFERENT TESTS IN TERMS OF THE EXPERIMENTAL GROUPS

The averages and variability of the scores. In Table III are included the means and SDs for each group for each of the tests. The average for the total group is also shown in each case. The SD of the total group does not appear because it would be misleading, in view of the fact that the total experimental group does not present a normal distribution. From Table III two observations are apparent. First, by groups, the tests tend to differentiate much as expected. Second, individual diagnosis on the basis of a single test is precluded by the large SDs. The expected range of scores is a decrease in D. Q. from

TABLE III

MEAN AND SD FOR EACH OF THE GROUPS FOR EACH TEST IN TERMS OF D. Q.

	Right		Ambi-dextrous		Stut-terers		Left		Total
	M	SD	M	SD	M	SD	M	SD	M
1. Dallenbach, position *vs.* intensity	48	34	45	27	46	30	52	36	48
2. Laterality index questionnaire	99	1	76	11	71	31	15	6	65
3. Miles ABC vision test	71	42	82	35	71	43	41	48	66
4. Adapted hole-in-card sighting test	63	44	60	46	45	47	20	39	47
5. Convergence strength	59	24	68	29	49	29	33	28	52
6. Star tracing	54	9	52	6	52	5	51	8	52
7. Van Riper critical-angle board	55	8	52	9	51	6	47	7	51

right handed *S*s to ambidextrous or stutterers and then to left handed *S*s. The adapted hole-in-card sighting test, the star tracing test, the Van Riper critical-angle board and, of course, the laterality questionnaire all show the group averages in this expected order.

The Miles ABC vision test and the convergence strength test reverse the order of the right handed and the ambidextrous groups. As one would expect from the negative correlations of Table II and the findings of Dallenbach (6, 13, 41) of attentional advantage for the left visual field of right sided persons and *vice versa*, with the Dallenbach technique the left handed group shows a higher average D. Q. than the right handed group. However, the ambidextrous group and stutterers do not fall between as one would expect.

Discrimination of the tests in terms of group averages. To determine the reliability of the differences between the means of the different groups for the various tests as shown in Table III the CR between the means of each of the groups was obtained. The results are shown in Table IV. It will be noted that, aside from the Dallenbach technique, each of the tests discriminates the right handed from the left handed groups and each of the tests discriminaets in one or more additional cases, as right handed from stutterers, *etc.*

Combinations of the Tests Suggestive of a Testing Battery

Because of the lack of diagnostic value of individual tests as shown in Table III and because of the fairly low reliability of the group discrimination of the individual tests as shown in Table IV,

TABLE IV

Chances in 100 That the True Difference of the Means is Greater Than Zero

		Left	Ambi-dextrous	Stut-terers
1. Dallenbach, position *vs.* intensity	R	63	62	57
	L		74	70
	A			55
2. Laterality index questionnaire	R	100	100	100
	L		100	100
	A			73
3. Miles ABC vision test	R	98	81	51
	L		100	98
	A			80
4. Adapted hole-in-card sighting test	R	100	58	88
	L		100	96
	A			84
5. Convergence strength	R	100	85	87
	L		100	96
	A			98
6. Star tracing	R	87	83	87
	L		64	58
	A			58
7. Van Riper critical-angle board	R	100	86	95
	L		97	98
	A			63

six of the measures have been considered in various combinations to point toward a battery that will give higher diagnostic value and greater reliability than any of the tests individually. The combinations have been treated in terms of M, SD and CR, as have the individual tests.

Average scores and variability of scores for the different combinations. In Table V are shown the mean and SD of each group for each of 14 different combinations of the tests. The letters to the left indicate the particular combinations considered which can be identified in each case by the accompanying key. It will be noted that the first seven combinations omit the laterality index questionnaire. The last seven combinations are the same as the first seven except that in each case the laterality index questionnaire has been added. Of the first seven combinations no one is satisfactory for individual diagnosis. Of the last seven combinations, K, M, J and L are most discriminating, and of these L is the only combination which separates the right and left handed groups without overlapping.

TABLE V

MEANS AND SDs FOR EACH GROUP

The letters on the left indicate the group of tests considered in each case. Scores in terms of D. Q.
The key to the letters is included below the table.

	Right		Ambidextrous		Stutterers		Left	
	M	SD	M	SD	M	SD	M	SD
A	60	20	63	16	54	17	38	20
B	58	16	58	16	49	15	38	15
C	56	9	57	9	51	10	44	11
D	57	16	55	15	49	16	40	13
E	55	6	52	6	52	4	49	5
F	59	23	56	22	49	24	34	19
G	59	23	56	23	49	23	36	20
H	67	16	64	12	58	17	35	18
I	66	13	62	13	54	16	32	11
J	67	7	64	12	56	13	37	9
K	68	12	60	12	55	17	33	10
L	71	5	60	5	58	11	38	4
M	69	16	63	15	54	22	26	12
N	72	16	63	16	56	23	29	14

KEY TO LETTERS IN LEFT COLUMN OF THE ABOVE TABLE

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Laterality index questionnaire								x	x	x	x	x	x	x
Miles ABC vision test	x							x						
Adapted hole-in-card sighting test	x	x		x		x	x	x	x		x		x	x
Convergence strength test	x	x	x					x	x	x				
Star tracing	x	x	x	x	x		x	x	x	x	x	x		x
Van Riper critical-angle board	x	x	x	x	x	x		x	x	x	x	x	x	

Discrimination of the various combinations in terms of averages of the experimental groups. The averages of the groups for the combinations of tests in Table V have been considered for the reliability of their discrimination by determining the CR in each case. The results are shown in Table VI. The tests combined in each case are indicated by the letters on the left hand side of the table. The key to the letters is included with Table V. Each combination or battery discriminates, more or less satisfactorily, right handed from left handed and from stutterers and left handed from stutterers and from ambidextrous individuals, and tends to discriminate stutterers from right handed and from ambidextrous subjects.

The choice of the best battery or batteries depends upon the groups to be discriminated as shown in Table VII. If one wishes to discriminate in all cases, M is the best battery for the purpose. If one wishes to discriminate in all cases except ambidextrous from

TABLE VI

CHANCES IN 100 THAT THE TRUE DIFFERENCE OF THE MEANS IS GREATER THAN ZERO

		Left	Ambidextrous	Stutterers
A.	R	100	65	87
	L		100	100
	A			96
B.	R	100	51	96
	L		100	99
	A			96
C.	R	100	65	96
	L		100	98
	A			99
D.	R	100	72	94
	L		100	98
	A			86
E.	R	100	93	98
	L		95	94
	A			64
F.	R	100	64	92
	L		100	98
	A			85
G.	R	100	64	91
	L		100	96
	A			84
H.	R	100	73	96
	L		100	100
	A			90
I.	R	100	86	100
	L		100	100
	A			96
J.	R	100	81	100
	L		100	100
	A			99
K.	R	100	98	100
	L		100	100
	A			85
L.	R	100	100	100
	L		100	100
	A			80
M.	R	100	90	99
	L		100	100
	A			91
N.	R	100	97	99
	L		100	100
	A			84

The tests combined in each case are shown by the letters at the left side of the table, according to the key given in Table V.

stutterers, L is to be preferred, with K, N and E next. If the discrimination is sought for all cases except right from ambidextrous, the best batteries are I, J, B and C. If one wishes to discriminate between all groups except right and ambidextrous, and ambidextrous and stutterers, the best batteries are I, J, K, L with B, C and D next.

V. Conclusions.

Dallenbach, position vs. intensity. Some *S*s responded in the manner suggested by Dallenbach as typical for the right and left handed types. However, there were many exceptions. Perhaps the technique is not suitable for naïve *S*s—it was not designed for such. Perhaps the few cases investigated by Dallenbach were not typical, a conclusion that deserves consideration in view of the experiments of Stevens (33), Whipple (40), and Cooper (10).

Aside from the direct aim of the present investigation it should be pointed out that this study definitely affirms Dallenbach's postulate that position is a determinant of attributive clearness.

TABLE VII.

COMBINATIONS GIVING BEST YIELD FOR VARIOUS DISCRIMINATIONS BETWEEN THE GROUPS

	Test Batteries in Order of Preference											
For discrimination in:	B	C	D	E	I	J	K	L	M	N		
All cases									1			
All cases except ambidextrous-stutterers				4			2	1		3		
All cases except right-ambidextrous	3	4			1	2						
All cases except right-ambidextrous and ambidextrous-stutterers	5	6	7		1	2	3	4				

Miles ABC vision test. It will be noted by examination of Table VII that this test is not included in any of the batteries selected as most satisfactory.

Adapted hole-in-card sighting test. By reference to Table VII it will be seen that this test is included in several of the batteries selected as most satisfactory. The difference between the results with two sighting tests, a difference borne out by Buxton and Crosland's (7) recent study, may tend to explain the difference in results of eyedness investigations of Mills (26), Parson (30), Downey (16), Rider (31) and others. It appears that the two tests appeal to some factor sometimes at variance with whatever common factor they may test. Since the adapted hole-in-card test correlates more highly with convergence strength than does the Miles ABC test, it seems possible that the hole-in-card test may accent muscular control. It will be remembered that the hole-in-card test here used was planned to make sighting as difficult as possible.

Convergence strength. This test is included in some of the most preferred batteries (Table VII). It is correlated more highly with the hole-in-card sighting test than with the Miles sighting test (Table II).

Star tracing test. This test was present in all the preferred battery combinations except one (Table VII). It was interesting in the raw data to note that frequently in cases where the Van Riper angle board failed to discriminate, the star tracing test did discriminate

and *vice versa*. This, of course, is informative as to why they serve well with each other in a battery.

Van Riper critical-angle board. As was expected this test was included in all the best batteries. This test would doubtless be more discriminative than at present if a method were developed of taking into account the gradations of departure from normal in the drawing of the patterns. For example, a pattern scored as partially reversed might show only a minor part or practically all of it reversed. A tendency of some *S*s to draw a pattern or write script sidewise or even upside down probably possesses direct significance that is being excluded from the scoring at present. The studies of Fildes and Myers (18) and Orton (29) lend strength to this conjecture.

Combinations of the tests. While the batteries of tests do not give promise of reliable individual diagnosis of native handedness they do in certain instances give quite reliable group discriminations (Table VII). It is hoped that this study, together with that of Durost (17) and Johnson and Duke (22) will result in the development of a means of reliable individual diagnosis.

VI. Summary.

The study reaffirms the need of a more adequate single test of laterality or a battery, the individual tests of which will compensate for each other's weaknesses. Certain of the batteries appear quite satisfactory for group discrimination, but all appear quite unsatisfactory for individual diagnosis. A single test or a battery of tests, satisfactory in all respects, is yet to be devised.

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Tentative Program

of the

American Speech Correction Association

HOTEL CLEVELAND, CLEVELAND, OHIO

DECEMBER 27, 28, 29, 30, 1938

INCLUDING JOINT PROGRAM WITH

National Association of Teachers of Speech

TUESDAY, DECEMBER 27

MORNING

9:00 A. M. Business Meeting of the American Speech Correction Association

11:00 A. M. President's Address—DR. MAX A. GOLDSTEIN, M. D.

11:30 A. M. Forum: "The Year, 1938, in Speech Disorders"

12:00 Noon. Recess

AFTERNOON

Technical Papers

2:00 P. M. Some Semantic Aspects of Stuttering, WENDELL JOHNSON, Ph. D., Iowa

2:25 P. M. Discussion

2:40 P. M. Oral Recitation Problems of Stutterers. Case Study, THELMA A. KNUDSON, South Bend, Ind.

3:05 P. M. Discussion

3:20 P. M. Personality Traits of College Stutterers, JAMES F. BENDER, Queens College, New York City

3:45 P. M. Discussion

4:00 P. M. Speech Physiology

4:25 P. M. Discussion

4:40 P. M. Effect of Deafness on Speech and Voice, MARIE K. MASON, M. A., Ohio State University

5:00 P. M. Discussion

5:10 P. M. Recess

WEDNESDAY, DECEMBER 28

JOINT MEETING OF

AMERICAN SPEECH CORRECTION ASSOCIATION

AND

NATIONAL ASSOCIATION OF TEACHERS OF SPEECH

Program on subject of SPEECH DISORDERS

PRINCIPLES AND PRACTICE

MORNING

General Assembly of Both Societies

9:30 A. M. Address—PROF. J. T. MARSHMAN, President, National Association of Teachers of Speech

10:00 A. M. Address—Practical Aspects of Speech Correction, MAX A. GOLDSTEIN, M. D., President, American Speech Correction Association

10:30 A. M. Panel—The interfunction of the Elementary Teacher and the Speech Therapist in the Speech Problems of School Children

12:15 P. M. Recess

AFTERNOON

2:00 P. M. The Problem of Stuttering:

2:25 P. M. Discussion

2:40 P. M. Treatment of Stuttering:

3:00 to 5:00 P. M. Panel Discussion, based on the practice of some Universities and Public Schools

5:00 P. M. Recess

THURSDAY, DECEMBER 29

JOINT PROGRAM

MORNING

9:30 A. M. The Problem of Functional Dyslalias in Adults

10:00 A. M. Discussion

10:20 A. M. Methods of Treatment for Adults

10:45 A. M. Discussion

11:00 A. M. Problem of Functional Dyslalias in Children

11:25 A. M. Discussion

11:40 A. M. Methods of Treatment for Children

12:05 P. M. Discussion

12:20 P. M. Recess

AFTERNOON

2:00 P. M. Problem of Functional Vocal Disorders
2:30 P. M. Discussion
3:00 P. M. Methods of Treatment for Adults
3:25 P. M. Discussion
3:40 P. M. Methods of Treatment for Children
4:05 P. M. Discussion
4:20 P. M. Problem of Vocal Training in Organic Dysphonias
4:45 P. M. Discussion
5:00 P. M. Recess

FRIDAY, DECEMBER 30

MORNING

Joint Program

Problems in the Educational Field

9:30 A. M. The Traveling Clinic
10:10 A. M. Discussion
10:20 A. M. The Speech Survey
10:45 A. M. Discussion
11:00 A. M. Introducing Speech Correction Classes into New Public School Systems
11:25 A. M. Discussion
11:40 A. M. Techniques in Foreign Dialect
12:05 P. M. Discussion
12:20 P. M. Recess

MORNING

Technical Section

AMERICAN SPEECH CORRECTION ASSOCIATION

9:30 A. M. Pre- and Post-Speaking Breathing of Stutterers and Non-stutterers, E. H. HENRIKSON, Ph.D., Iowa State Teachers College, Cedar Falls, Iowa
9:55 A. M. Discussion
10:10 A. M. Stuttering in Relation to Size and Personnel of Audience, HARRIET PORTER, Dept. of Speech, Simpson College, Indianola, Iowa
10:35 A. M. Discussion

FRIDAY, DECEMBER 30

MORNING
(Continued)

10:50 A. M. Ear Training Techniques in Treatment and Articulating Disorders, C. VAN RIPER, Ph.D., Western Speech Clinic, Kalamazoo, Michigan
11:15 A. M. Discussion
11:40 A. M. Prognosis in Post Operative Cleft-Palate Speech
12:15 P. M. Discussion
12:30 P. M. Recess

AFTERNOON

Problems in the Technical Field

2:00 P. M. The Problem of Cleft-Palate Speech
2:25 P. M. Discussion
2:40 P. M. Methods for Re-education of Cleft Palate Speech
3:05 P. M. Discussion
3:20 P. M. The Problem of Spastic Speech
3:45 P. M. Discussion
4:00 P. M. Methods of Treatment for Spastic Speech
4:25 P. M. Discussion
4:40 P. M. Adjournment

CONVENTION NOTICES

All members of the A. S. C. A. who desire to be considered for a place on the Joint Program with the N. A. T. S. but have not replied to Dr. H. J. Heltman's request of August, please send him immediately a full outline or a short brief on the topic desired for consideration. Address your communication to him in care of School of Public Speech, Syracuse University, Syracuse, New York. It must be in his hands not later than October 20th.

Papers are to be limited to twenty minutes as is customary. Also, as in recent years, no papers will be read in the absence of the contributing author. Each person assigned a place on the program will be expected to appear in person to present his material.

A complete program of the A. S. C. A. Convention, including the Joint Meetings with the N. A. T. S., will be published in the December issue of The Journal of Speech Disorders, which will be mailed early in December.

A CONDITIONED REFLEX STUDY OF STUTTERING

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Kent, Ohio

I. Introduction. Most laboratory studies of the breathing disturbances which accompany stuttering have approached the problem through an analysis of records secured while *S* was speaking in a more or less natural manner. As these studies became more and more refined in technique, greater attention was directed to the character and degree of relationship between the various symptoms of stuttering and the overt spasm. The investigations of Travis (17), Henrikson (7), Strother (16), and Morley (9) showed this interest. The aim underlying all these attempts to discover the actual relationship between the symptoms and the act itself was, of course, to more completely formulate a theory of the causation of stuttering.

The purpose of the present study, likewise, was to investigate the relationship between breathing disturbances and stuttering, and to determine if possible whether a theory now advanced by Bluemel (2) has a basis in experimental fact. The postulates of this theory are, first, that stuttering primarily is caused by a conflict between the conditioned reflex of speech and inhibition of the speech reflex, and second, that the asynergies which accompany stuttering result from the irradiation of inhibition. Since the reports mentioned above have not shown any consistent or understandable relation between the asynergic functioning of the breathing mechanism and the spasm, an experiment was set up to answer the following questions:

1. Are there, between stutterers and normal speakers, any differences in "conditionability" which might serve to explain stuttering as a conflict between the conditioned reflex of speech and inhibition of that reflex?
2. Are breathing anomalies the result of the irradiation of inhibition?
3. Is there a cause of breathing disturbances which, if discovered, would explain the failure of careful investigators to find any consistent relationship between the overt spasm and the disturbances?

It was believed that the method of approach followed by previous investigators should not be completely abandoned. Yet, if a controlled investigation of the conditionability of stutterers and normals was to be made, an actual speaking or reading situation was out of the question, since if the theory being examined were true, previous conditioning would not thus be taken into account. Consequently,

nonsense syllables involving the speech functions but having no meaning to the *S*s, and whose presentation and temporal relationship to each other and to the unconditioned stimulus could be rigidly controlled, were chosen as the conditioned stimuli. The reflex to be conditioned must likewise call into play an essential part of the speech mechanism. Since the investigations of Garvey (6) and Scott (14) had shown that increases and decreases in the irregularity of respiration were conditionable, the reaction chosen for conditioning was the respiratory response. Thus, with conditioned stimuli involving both the overt and the covert speech functions, and a conditioned response involving the part of the speech mechanism the malfunctioning of which had been most often observed in stutterers, the experimental findings should be capable of meaningful interpretation.

II. Subjects. Usable records were obtained from 18 stutterers from the speech clinic, and 17 normal speakers enrolled in the university, in the main experiment. Five normals who were not used in the main experiment were used in a supplementary one. The age range of the stutterers was 17 to 26, of the normals, 18 to 39. All but three in each group were in the range from 18 to 25.

III. Apparatus. Four nonsense syllables, 'tos,' 'kif,' 'fip,' and 'tok' were recorded on an acetate disc. 'Tok,' the fourth, was used as the conditioned stimulus. Undoubtedly all four of the syllables were conditioned to some extent, but for the purpose of the experiment and under the conditions of presentation, that did not matter. A lug was placed in the rim of the record on a radius which passed directly through the point where 'tok' was recorded. A light flexible switch made of two phosphorous bronze strips, ⅜ in. by 6 in., fastened firmly to a bakelite post and resting two mm. from bronze studs in a second bakelite post, was clamped to the corner of an electrically driven phonograph in such a manner that it could be lowered to the edge of the record and closed by the pressure of the lug. Thus, as soon as 'tok' was played on the record, the switch was lowered and one revolution following the syllable, the lug struck the extension of the strips and closed separate circuits. One strip of the switch completed a circuit between a variable condenser with a range of .001–8 mfd., charged from a source of direct current which would supply any voltage from 0 to 300. By means of a potentiometer, the strength of the shock could be varied. A second strip on the switch closed a circuit between two dry cell batteries and a magnetic marker which was placed against smoked-paper on a kymograph, and indicated on the breathing records the point of shock, or, if the condensor was disconnected, as it was during the before-conditioning (BC) and after-conditioning (AC) trials, the point at which the shock should have been given.

A second acetate disc upon which the first three syllables were recorded directly from the four syllable record was used as the stimulus to evoke the speech response each *S* made with the fourth syllable.

Two silver thimbles wrapped with waterproof tape, in which were placed small pieces of sponge soaked in saturated salt solution,

served as electrodes. These were placed on the index and middle fingers of the preferred hand.

The phonograph which was used to play the stimulus records, and the condenser were placed in a small room back of the sound-proof experimental room. The pick-up of the phonograph was connected to a loud speaker in the experimental room. This speaker had a uniform frequency response up to 6000~ so that reproduction of the syllables was sufficiently accurate for purposes of the experiment.

The speech responses were recorded on acetate and aluminum discs by means of a Fideletone recorder. The microphone of the recorder was placed so that syllables from the loud speaker as well as the syllable spoken by *S* could be recorded.

The sound waves recorded on the discs were then photographed by means of the phonelegraph (*cf.* Cowan, 3). Briefly the procedure was as follows: The phonograph record was securely clamped to the turntable in the center of a large drum. Vertical to this drum was a smaller one, so geared that it made one revolution to six revolutions of the phonograph record. The acoustic energy was transformed into electrical energy by an electro-magnetic phonograph pick-up, and the electrical energy was transmitted to an audio-frequency amplifier, the output of which led to head-phones and an optical lever. The beam of light was focused upon Eastman No. 1, four-in. film placed around the vertical drum. As the record was being played, the optical lever was slowly moved past the small drum, vertical to the plane of revolution. As soon as the last of the four syllables had been said, a heavy card was held to interrupt the beam of light from the optical lever until surface noise on the record indicated that a new series of sounds were soon to occur. This method made it easy to identify the syllables and saved film.

The syllables were originally recorded at a speed of 78 r.p.m. Fig. 1 is a reproduction of a section of the film. Inspection of it will make clear how the syllables were identified and labeled.

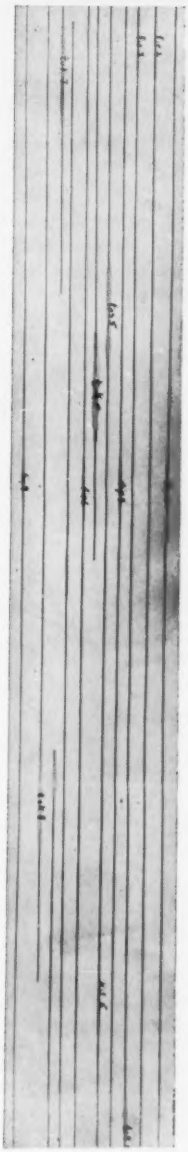

FIG. 1. Section of a phonelegram. Four syllables were recorded before a card was held between the beam of light and the film to break the line into sections. The films were read from left to right, 'tok' being the last syllable recorded before the line was broken.

In order to determine accurately the constancy of the speed of the phonograph and the constancy of the time interval between the last syllable and the shock, the following method was used. An electric bell was connected to the switch which closed the circuit discharging the condenser, and 40 recordings of the four syllables and the bell were made. Phonelegrams then were made in the manner described above. The time interval between the third and fourth syllables was 1.955± .007 sec., while the interval between the last syllable and the shock was .861± .004 sec.

IV. Procedure. The procedure consisted of three steps. The first step was for the purpose of measuring the ability of the stutterers and normals to reproduce the time interval between the third and fourth syllables before they had been presented with the shock. Breathing records were taken at the same time by means of a Stoelting

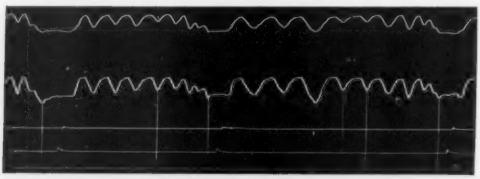

FIG. 2. Tonic blocks and opposition between the thorax and the abdomen while *S* listened to the four syllables in the post-conditioning period of step two. In this and all subsequent records, the bottom line shows time in seconds; deviations in the line next to the bottom indicate points at which 'tok' was heard; deviations in the third line mark the points at which the shock had been presented, in relation to 'tok,' in the conditioning period. The top line shows movements of the thorax, and the line next to the top, movements of the abdomen, downward strokes recording inspiration and upward strokes expiration. All records shown were taken from normal speakers. The *S* of this record exhibited, likewise, horizontal dysintegration and marked dysintegration as he spoke the symbol after conditioning.

kymograph and two Sumner pneumographs attached to Jacquet tambours. A Jacquet chronometer marked off time units of one second, and a magnetic marker was used to indicate on the smoked-paper record the time at which the 'tok' was uttered. The pneumographs were placed around the thorax and around the abdomen. Records of from 20 to 30 complete respiratory cycles were secured during this period. The mean of these served as an index to the BC respiration during a speaking period. Five measures were made of all breathing records. The duration of inspiration and expiration were measured by means of Morley's (9) adaptation of Fossler's (4) technique. Since the kymograph did not run at constant speed, it was necessary to measure in millimeters each interval of one second as marked by the chronometer, and calculate the duration of a wave from the length of the intervals directly beneath the wave being measured. The amplitude of inspiration and expiration, and the

irregularity of inspiration level were measured by a linear oscillometer designed after that of Hull (8). One modification was made. The discs were calibrated to read in millimeters rather than in fortieths of an inch. The irregularity of inspiration level was measured by moving the pointer of the oscillometer from trough to trough of the respiration cycles.

After *S* had been placed before the loud speaker and microphone, the following instructions were read and carefully explained:

> "You will hear a record of four syllables, 'tos,' 'kif,' 'fip,' 'tok.' You are to listen carefully, noting particularly the temporal relationship of the third syllable, 'fip,' to the fourth, 'tok.' Try to fix firmly in your mind how long a time elapses between the third and the fourth syllables. After you are confident that you have the time in mind, you will hear another record playing the first three only. These three are timed exactly as they were on the first record. You are to speak the fourth 'tok' into the microphone so that the record which is made of the first three syllables as they are sounded from the loud speaker and the fourth as you speak it will exactly duplicate the time intervals between the four syllables you listened to. You will make ten recordings, one closley after another."

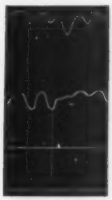

FIG. 3. Conditioned antagonism between the thorax and abdomen, as *S* listened to the four syllables played on the record. Electrodes in place. Signal line indicates point at which shock had been given during the conditioning stage.

Before an *S* was permitted to go further in the experiment, he was asked whether the syllables suggested anything to him. If they did, he was dismissed. Five *S*s were excused for that reason, and the records of three others were discarded because instructions had not been followed.

The record of the four syllables was played from 40 to 50 times for each *S* before he was asked to speak the fourth into the microphone in response to the first three. Care was taken not to ask an *S* to speak the syllable before he was confident he could reproduce the interval accurately.

As described above, each *S* had ten trials in reproducing the time interval, and phonelegrams were made and measured. The average

of the ten trials was then used as the measure of the individual's ability to reproduce the interval accurately.

The second step in procedure was to establish a conditioned respiratory response. For controls, breathing records were taken while *S* listened to three playings of the four syllables. The four breathing cycles immediately preceding the point at which 'tok' was sounded, and the four cycles immediately subsequent to it were measured. This gave 24 curves, the mean of which served as an index to BC respiration during the listening period.

Each *S* then was tested for his sentitivity to electric shock. The voltage was increased until he objected to further increases. This maximum number of volts which *S* consented to receive was used throughout the experiment as the unconditioned stimulus. There was not a statistically significant difference between the groups relative to the strength of the unconditioned stimulus, so far as the strength of the stimulus could be measured objectively.

FIG. 4. Horizontal opposition as a conditioned response to the syllable. Top line represents the changes in right side of the abdomen; the second line represents changes in the left side of the abdomen.

To establish the conditioned response to the syllable 'tok,' the record was played 14 times, a shock following 'tok' each time. Eight breathing curves for each of the first three presentations of the shock were measured in the same way that the control curves were measured. After 14 paired presentations of the conditioned and unconditioned stimuli, there was a twelve minute silent interval.

The conditioned respiratory reactions were then secured by playing the record from six to eight times. Again the eight cycles for each of the first three presentations of the conditioned stimulus were measured as the control curves had been measured. The mean of these measures served as the index to the AC respiration during a listening period. Changes in the respiration of each *S* during the BC and AC period of this step were considered significant when the critical ratio was three or greater.

The third step in procedure was to determine the effect of conditioning the syllable upon the reproduction of the time interval. The syllable was reconditioned by 15 presentations of the paired stimuli, the same instructions as at the first being given. Ten reproductions

of the interval were then taken as in the first step. Breathing records were likewise secured as they had been in step one. The mean served as the index to the AC respiration during a speaking period.

The following sets of records, then, were taken during the experiment: simultaneous breathing and speech response records for BC and AC periods, and breathing records while the *S* listened to the stimulus syllables for BC, DC, and AC periods. Altogether, 5,025 respiration cycles and 800 time intervals were measured.

The records for step one were taken in February, those for step two in March and April, and those for step three in April and May of 1936. In the case of three stutterers and three normals, however, all three steps were completed during a single session. An analysis of the data revealed no difference between the records taken in one session and those taken in three. Since a session involving all three steps took about two hours and forty minutes, it was generally advisable to complete only one step in a session.

TABLE I

COMPARISON OF THE MEAN AVERAGE TIME INTERVALS OF STUTTERERS AND NORMALS

	BC		*AC*			
	M	SE	M	SE	CR	Chances in 100
Stutterers	2.52	.353	1.77	.195	.83	79
Normals	1.69	.071	1.62	.115	.52	69
Stutterers without those who stuttered	1.90	.138	1.54	.154	1.76	96

	CR	Chances in 100
Stutterers vs. normals before conditioning	1.14	87
Stutterers vs. normals after conditioning	.65	74
Stutterers without those who stuttered vs. normals before conditioning	1.40	92
Stutterers without those who stuttered vs. normals after conditioning	.42	66

V. Results.

The effect of the conditioned symbol upon the reproduction of the time interval. No significant differences in regard to the ability to reproduce the time interval between the third and fourth syllables were found to exist between normals and stutterers. Table I gives the mean interval in seconds as produced by the two groups in the BC and AC periods.

Six stutterers had spasms in speaking the syllable in the BC period, and one had spasms in the AC period. In those cases it obviously was impossible to consider a decrease in the time interval a result of conditioning the symbol. Consequently, the records of the 12 stutterers who had no spasms were also treated as a separate group.

The important facts to be observed in Table I are (1) that stutter-

ers are not differentiated from normal speakers, (2) that the responses of the normal group to the conditioned symbol shortened the time interval from 1.69 ± .07 sec. to 1.62 ± .11 sec., and (3) that the responses of the stutterers who had no spasms shortened the interval from 1.90 ± .14 sec. to 1.54 ± .15 sec. This reduction in the interval occurred in spite of the fact that the correct time interval was 1.955 sec. It appears, then, that even though the reduction in the mean interval is not statistically significant for either group, the tendency for both normals and stutterers to shorten the interval suggests that the effect of the shock was to accelerate rather than to inhibit the response. Especially does this interpretation seem justified if it is borne in mind that the *S*s had heard the syllables 42 times between the first period and the last, and therefore had more opportunity to perceive the interval correctly .

TABLE II

COMPARISON OF THE MEAN AVERAGE ERROR OF RESPONSE OF STUTTERERS AND NORMALS

	BC		*AC*			
	M	SE	M	SE	CR	Chances in 100
Stutterers	.470	.066	.567	.092	.86	80
Normals	.359	.046	.531	.074	1.98	97
Stutterers without those who stuttered	.388	.044	.623	.084	2.45	99

	CR	Chances in 100
Stutterers vs. normals before conditioning	1.37	91
Stutterers vs. normals after conditioning	.31	62
Stutterers without those who stuttered vs. normals before conditioning	.45	67
Stutterers without those who stuttered vs. normals after conditioning	.85	80

Furthermore, this tendency to hurry the response caused an increase in the mean error of response of stutterers and normals alike. This is shown in Table II. The consistency of the data, and the fact that hurrying the response would be opposed by the effort to reproduce the interval accurately, indicates further that the effect of conditioning the speech symbol was to excite rather than inhibit a speech response made with it.

If the records of individuals are considered, doubt on the point is removed. Table III reveals that of the 12 stutterers who had no spasms, 50 per cent had significant reductions in time, and that for 41 per cent this reduction meant a significant increase in error. On the other hand, none of this group increased the interval significantly. Of the normal speakers, 29 per cent had significant decreases in time accompanied by significant increase in error, while only six per cent had a significant increase in time accompanied by a significant increase in error. The tendency to speak the conditioned symbol too

quickly is further shown by the correlations between decrease in time and increase in error.[1] The correlation for the normals was .59± .11 while that for the stutterers who had no spasms was .43± .17.

TABLE III

COMPARISON OF SIGNIFICANT CHANGES IN TIME AND ERROR OF RESPONSE OF STUTTERERS AND NORMALS AFTER CONDITIONING

	Stutterers		Normals		Stutterers Without Those Who Stuttered	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Significant increases in time	1	6	6	35	0	
Significant decreases in time	8	44	6	35	6	50
Significant increases in error	8	44	6	35	8	66
Significant decreases in error	3	17	2	12	1	9
Significant decreases in time accompanied by significant increases in error....	5	28	5	29	5	41
Significant increases in time accompanied by significant increases in error....	1	6	1	6	0	

The effect of the conditioned symbol is further clarified by the subjective report given in Table IV. That the acceleration of the speech response had its basis in the dread and anticipation of the shock accompanying the syllable seems likely. It is noteworthy

TABLE IV

SUBJECTIVE REPORT OF STUTTERERS AND NORMALS

	Stutterers		Normals	
	No.	Per Cent	No.	Per Cent
Anticipated shock while listening	17	94.4	16	94.1
Did not anticipate it while listening	1	5.6	1	5.9
Anticipated shock while speaking	15	83.3	14	82.2
Did not anticipate it while speaking	3	16.7	3	17.8
Shock was unpleasant	17	94.4	15	88.2
Shock was not unpleasant	1	5.6	2	11.8
Dreaded hearing 'tok'	17	94.4	15	88.2
Did not dread hearing 'tok'	1	5.6	2	11.8
Dreaded speaking 'tok'	15	83.3	14	82.2
Did not dread speaking 'tok'	3	16.7	3	17.8
Anticipation of shock worse than shock	13	72.2	12	70.6
Shock worse than anticipation	4	22.2	4	23.5
No difference between shock and anticipation	1	5.5	1	5.9

that although the unconditioned stimulus was presented only when the conditioned symbol was being heard, never when it was being spoken, 83.3 per cent of the stutterers and 82.2 per cent of the normals anticipated a shock while speaking it. Furthermore, the same

[1] In the calculation of these correlations, and of all subsequent ones, the method of rank-differences was used; r was determined from the table given by Garrett (6, p. 192).

TABLE V

MEAN AVERAGE MEASURES OF RESPIRATION OF STUTTERERS AND NORMALS, SPEAKING 'TOK' BEFORE AND AFTER CONDITIONING

	Stutterers						Normals					
	BC		*AC*			Chances	*BC*		*AC*			Chances
	M	SD	M	SD	CR	in 100	M	SD	M	SD	CR	in 100
Irregularity of inspiration....	6.65	4.03	6.42	4.49	.16	56	6.74	4.03	6.63	5.29	.25	60
Amplitude of inspiration.....	17.13	5.12	17.90	10.39	.28	61	16.43	8.70	13.51	8.69	1.00	84
Duration of inspiration.....	1.15	.22	1.19	.66	.29	61	1.00	.22	1.13	.1	2.20	99
Amplitude of expiration.....	18.39	5.33	18.70	7.22	.69	75	17.22	9.00	14.18	6.08	1.11	87
Duration of expiration.....	2.03	.42	1.73	.45	2.07	98	1.79	.33	1.82	.5	.50	69

In this and all subsequent tables of measures of respiration, duration, values are in seconds, and amplitude and irregularity values are in millimeters.

83.3 per cent and 82.2 per cent respectively dreaded to speak the syllable. This report considered along with the objective data shows unmistakably that a language symbol which is unpleasantly conditioned in a listening situation is still unpleasantly conditioned when used in a speech situation.

From the analysis of the phonelegrams, then, two important facts stand out. First, the chief effect of conditioning a language symbol is to hurry and not to delay a speech response made with that symbol. Second, stutterers are not differentiated from normal speakers by the effect which a conditioned stimulus has upon the ability to reproduce a time interval accurately.

Further interpretation of the first fact is warranted. It seems reasonable to suppose, if Bluemel's theory that shock or trauma inhibits the speech reflex is true, that an electric shock severe enough to produce anticipation and dread should have tended to delay a speech response made with a symbol with which the shock was associated. Instead, the main tendency is for the speech response

FIG. 5. Conditioned response recorded three weeks after the last paired presentation of the conditioned and unconditioned stimuli. The electrodes were not on the fingers and the *S* was told that he would not, could not be shocked.

with the conditioned syllable to be hurried. According to the data here reported, a theory which postulates that inhibition of the conditioned speech response is a result of the unpleasant conditioning of speech symbols is not tenable. And a theory of stuttering which is based upon the premise that a conflict between the conditioned reflex of speech and inhibition of the reflex produces stuttering is likewise untenable. If further investigations should bear out the present findings to the effect that for both stutterers and normals unpleasantly conditioned speech symbols hurry a speech response, then it would seem more probable that stuttering occurs when the neurophysiological mechanism in unable to organize the speech response with the haste that the emotionally conditioned stimuli impose upon the speaker. In the present study the problem of organizing the hurried speech response was simple since it consisted of a single syllable. In case of more complex responses, the task of organization would be greater.

The effect of conditioning upon respiration. The analysis of the breathing records taken as *S* made ten responses with the stimulus syllable, both before and after the syllable had been conditioned, indicates that no difference obtained between stutterers and normals in regard to either the mean amplitude and duration of respiration and irregularity of inspiration or to the variability of the above measures. The important thing to note in Table V is that as a group, neither the stutterers nor the normals showed any significant changes in the measures of respiration as a result of conditioning the syllable. Table VI shows that neither before nor after conditioning was there any significant difference between the means of the measures of respiration of the normals and the means of the measures of respiration of the stutterers.

The mean coefficients of variation (CV) likewise indicate that there was no important difference between normals and stutterers, either before or after the symbol had been conditioned. Further-

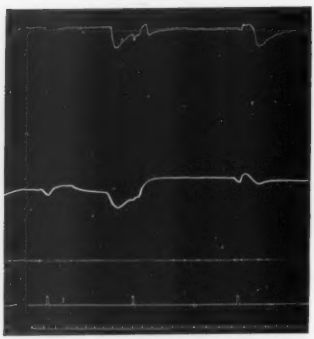

FIG. 6. Prolonged inspiration, interrupted inspiration, tonic blocks, and slight tremors in the thoracic movements, as *S*, who was a superior speaker, spoke the conditioned symbol.

more, as Table VII shows, the changes in variability after the symbol had been conditioned were relatively small and relatively the same for both groups.

The breathing records which were taken in the three phases of the second step (*S* listening to four syllables, listening to the syllables and receiving shock following fourth, listening to the syllables) are quite consistent with the data reported in the first step. Table VIII gives the mean average measures of respiration of stutterers and normals during the first and third phases. Table IX indicates that there are no differences between the two groups.

Since all five measures of respiration did not show the same number of significant differences, it is difficult to know to what degree respiration was affected by the conditioned stimulus. Significant changes in amplitude of expiration and inspiration occurred most frequently in both stutterers and normals. According to these two measures six stutterers and 11 normals exhibited a conditioned

respiratory response. The total number of significant changes in respiration with all five measures included was 20 for stutterers and 31 for the normals. Table X gives the number of significant changes in each measure of respiration for the two groups. These data indicate that the conditioned change in respiration may be either an increase in amplitude and duration or a decrease. Garvey (6), using only normal *S*s and measuring the irregularity of inspiration, found that conditioned changes might be either increases or decreases. In the data for all measures of respiration there is nothing which would suggest any direction of significant change in respiration. In fact, it would seem that the direction and the degree of change are very similar for the two groups.

TABLE VI

SIGNIFICANCE OF DIFFERENCES IN MEAN MEASURES OF RESPIRATION OF STUTTERERS VS. NORMALS, SPEAKING 'TOK' BEFORE AND AFTER CONDITIONING

	BC		*AC*	
	CR	Chances in 100	CR	Chances in 100
Irregularity of inspiration	.07	53	.05	52
Amplitude of inspiration	.27	61	1.36	91
Duration of inspiration	1.84	97	.38	65
Amplitude of expiration	.46	68	2.46	99
Duration of expiration	.30	62	.63	74

TABLE VII

COMPARISON OF AVERAGE COEFFICIENTS OF VARIATION OF RESPIRATION MEASURES OF STUTTERERS AND NORMALS, SPEAKING 'TOK' BEFORE AND AFTER CONDITIONING

	Stutterers		Normals	
	BC	*AC*	*BC*	*AC*
Irregularity of inspiration	89.58	83.42	82.75	84.31
Amplitude of inspiration	38.75	38.54	40.86	39.00
Duration of inspiration	29.20	26.11	36.28	27.62
Amplitude of expiration	35.00	37.52	43.39	44.25
Duration of expiration	34.02	31.95	32.95	31.85

The measures of variability of respiration during the second step did not exhibit the likeness between stutterers and normals which had been so marked in all other records of respiration. However, the differences between the two groups in variability were not great. Inspection of Table XI shows that the mean coefficients of variation for all measures of respiration do not differentiate the two groups in regard either to direction of change or to degree.

A close examination of the measures of respiration shows emphatically that in every case the overlapping was very great and the differences unreliable. In no case was the lowest mean or the lowest CV in one group lower than the highest mean or the highest CV in the other group. In a word, the differences in each group were very

TABLE VIII

MEAN AVERAGE MEASURES OF RESPIRATION OF STUTTERERS AND NORMALS, LISTENING TO THE FOUR SYLLABLES BEFORE AND AFTER CONDITIONING

	Stutterers						Normals					
	BC		*AC*			Chances	*BC*		*AC*			Chances
	M	SD	M	SD	CR	in 100	M	SD	M	SD	CR	in 100
Irregularity of inspiration....	2.56	1.41	3.09	1.50	1.09	86	2.40	1.18	4.05	2.61	2.37	99
Amplitude of inspiration.....	19.68	5.98	18.57	5.43	.58	72	14.50	5.33	16.01	7.77	.66	75
Duration of inspiration.....	1.35	.20	1.30	.25	.55	71	1.32	.26	1.36	.41	.33	63
Amplitude of expiration.....	19.71	5.90	18.60	5.48	.58	72	14.36	5.31	16.07	7.75	.75	77
Duration of expiration.....	2.01	.41	1.90	.50	.72	76	2.01	.49	2.22	1.12	.71	76

much greater than the differences between the average measures in the two groups.

Correlations between error in time interval and variability of respiration. In an effort not to overlook any possibilities of a difference between stutterers and normals, it seemed advisable to examine the relationship between the effect of conditioning upon the accuracy with which the time interval was produced and the effect upon variability of respiration. Consequently, the increase in the error of the speech response was correlated with the increase in the

TABLE IX

SIGNIFICANCE OF DIFFERENCES IN MEAN MEASURES OF RESPIRATION OF STUTTERERS VS. NORMALS, LISTENING TO THE FOUR SYLLABLES BEFORE AND AFTER CONDITIONING

	BC		*AC*	
	CR	Chances in 100	CR	Chances in 100
Irregularity of inspiration	.36	64	.32	63
Amplitude of inspiration	2.71	99	1.13	87
Duration of inspiration	.37	64	.44	67
Amplitude of expiration	2.82	99	1.11	87
Duration of expiration	.003	50	1.08	86

TABLE X

COMPARISON OF SIGNIFICANT CHANGES IN RESPIRATION OF STUTTERERS AND NORMALS, LISTENING TO THE FOUR SYLLABLES AFTER CONDITIONING

	STUTTERERS				NORMALS			
	Increase		Decrease		Increase		Decrease	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Irregularity of inspiration.	0		0		1	6	0	
Amplitude of inspiration..	2	11	4	22	6	35	5	29
Duration of inspiration....	0		1	5	2	11	3	17
Amplitude of expiration...	2	11	5	28	6	35	5	29
Duration of expiration....	2	11	4	22	2	11	1	6

CV of each of the five measures of respiration. In this way it could be determined whether or not the relative effects of conditioning the stimulus upon the two types of response to it (speech and breathing) were the same for both groups. Table XII gives the correlations. In view of the generally low correlations and the high probable errors, it seems that no significant differences exist between the correlations for the two groups. To check further, however, and to determine whether any relationship held between the error in reproducing a temporal pattern with the speech mechanism and variability in measures of respiration, the measures of those functions were correlated for both groups in the first and third steps. The results are shown in Table XIII. Again it is apparent that stutterers are not to be differentiated from normals by a difference in the relationship between variability in respiration and error of response.

Conditioned dysintegration of breathing. During a preliminary investigation it became apparent that if the shock were severe enough, a general dysintegration of breathing movements resulted. Furthermore, it soon became apparent that this dysintegration was conditionable.

A survey of previous studies of the conditioned respiratory reaction and of respiration changes during emotional stimulation revealed that conditioned dysintegration had not been reported. Hull's (10) excellent summary of the work on the conditioned reflex makes no mention of it. Conditioned changes in respiration have been reported often enough but not conditioned dysintegration. Ray (13) and Blatz (1) reported conflicting data in regard to the

TABLE XI

COMPARISON OF AVERAGE COEFFICIENTS OF VARIATION OF RESPIRATION OF STUTTERERS AND NORMALS, LISTENING TO 'TOK' BEFORE AND AFTER CONDITIONING

	Stutterers		Normals	
	BC	*AC*	*BC*	*AC*
Irregularity of inspiration	86.45	89.15	111.40	88.28
Amplitude of inspiration	16.50	20.39	29.02	34.75
Duration of inspiration	16.45	18.95	20.83	24.72
Amplitude of expiration	16.55	15.79	27.37	33.33
Duration of expiration	21.84	24.87	24.92	32.80

TABLE XII

CORRELATION OF INCREASE IN ERROR OF RESPONSE WITH INCREASE OF VARIABILITY OF RESPIRATION

	Stutterers		Normals	
	r	PE	r	PE
Irregularity of inspiration	—.17	.16	.31	.15
Amplitude of inspiration	.62	.10	.03	.15
Duration of inspiration	.28	.15	—.26	.16
Amplitude of expiration	.37	.14	—.37	.15
Duration of expiration	.17	.16	—.19	.17

change in respiration rate which resulted from the fear of falling. However, both reported an increase in the I/E ratio. Skaggs (15) reported an increase in rate and amplitude of respiration during states of startledness and excited expectancy. Watson (19), using an electric shock as an unconditioned stimulus and a bell as a conditioned stimulus showed that a sudden inspiration could be established as a conditioned reponse in dogs and fowls. The findings of Scott (14) and Garvey (6) have already been mentioned. Since all of these investigators except Skaggs used a single pneumograph, however, such an anomaly as opposition between thorax and abdomen would not be observed. Skaggs' study did not deal with conditioned changes in respiration. Also, the stimulation was of such nature that tonic or clonic blocks, or interrupted expirations were not likely to appear.

In the present study the records of breathing taken during the two AC periods were examined and the type and the frequency of appearance of anomalies noted. The breathing curves analyzed totalled 948 for the normals and 936 for the stutterers. Two hundred, or 21.1 per cent of the curves of the normal speakers, presented anomalies, while 103, or 11 per cent of the stutterers' curves, presented such anomalies. Figs. 2, 3, 4, 5, 6, and 7 are reproductions of records which show all the types of abnormalities observed. Table XIV shows the frequency of occurrence of those abnormalities.

Since it was clear that several of the anomalies in the breathing of stutterers during stuttering could be established as conditioned reactions, it seemed desirable to determine whether horizontal

TABLE XIII

CORRELATION OF AVERAGE ERROR OF RESPONSE WITH VARIABILITY OF RESPIRATION BEFORE AND AFTER CONDITIONING

	BC				*AC*			
	Stutterers		Normals		Stutterers		Normals	
	r	PE	r	PE	r	PE	r	PE
Irregularity of inspiration....	—.39	.14	.18	.17	.37	.14	—.47	.13
Amplitude of inspiration....	.32	.15	.26	.16	.22	.16	—.14	.17
Duration of inspiration....	.02	.17	.34	.15	—.29	.15	.01	.17
Amplitude of expiration....	.07	.16	.09	.17	.01	.17	—.26	.16
Duration of expiration....	.03	.17	.24	.16	—.25	.16	—.26	.16

TABLE XIV

FREQUENCY OF OCCURRENCE OF BREATHING ABNORMALITIES, IN PER CENT

Tonic block	33	29
Opposition between thorax and abdomen	24	27
Interrupted expiration (appeared only during the speaking of 'tok')	15	18
Clonic blocks	12	11
Tremors	9	7
Prolonged inspiration (appeared only during the speaking of 'tok')	7	3

dysintegration likewise could be conditioned. In a short supplementary experiment, the chair designed by V. Travis (18) was used. Ten normals were reconditioned to the syllable. Three hundred breathing curves which represented responses to six stimulations with the conditioned syllable were analyzed. Five per cent of these curves presented horizontal dysintegrations.

Eleven normals and five stutterers exhibited asynergic functioning of the breathing mechanism. This result is in close agreement with the number in each group whose respiration showed significant quantitative changes. The probable explanation seems to be that

many individual stutterers refused to take very severe shocks. Consequently their breathing was not so much affected even during the conditioning period. In all cases except two, individuals whose respiration was dysintegrated while they listened to the conditioned stimulus were the individuals whose breathing was asynergic while they spoke the conditioned stimulus.

It also appeared during the regular experiment that some *S*s showed little or no tendency to exhibit breathing abnormalities, even though the shock was as severe as it was possible to make it. Consequently, a second supplementary experiment was conducted. Five *S*s who had served in some of the preliminary experimenting, were paid to sit for a one and one-half hour period and receive 100 paired presentations of the stimuli, with the unconditioned stimulus at a value of 300 volts and 4 mfd. Following the period of conditioning, 48 breathing cycles of each *S* were recorded during six presentations

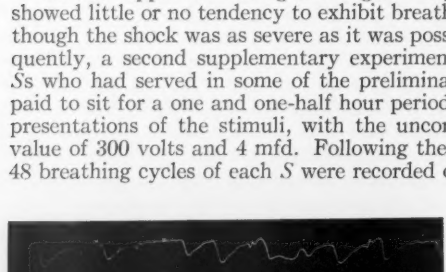

FIG. 7. Tonic blocks, interrupted expiration, and opposition between thorax and abdomen as *S* spoke the conditioned symbol. *S* was a superior speaker from the freshmen speech classes in the University, and none of her records taken before the symbol was conditioned exhibited any abnormalities.

of the conditioned stimulus. In four of these no anomalies of any type appeared. The other *S* refused to continue the experiment after 200 stimulations. Before he was dismissed, however, 18 breathing cycles were recorded during three presentations of the conditioned syllable. Three of these cycles were of a tonic character.

The most reasonable interpretation which can be made of these results seems to be that breathing abnormalities like those during stuttering are possible conditioned reactions to some element or elements in the speech situation, and may be not at all a manifestation of the neurological disturbance that has its expression in stuttering. It also appears that not only conditioning factors but also differences in the neurophysiological structure of the individual account for the appearance of the anomalies. If this interpretation may be accepted, then the failure of such careful investigations as those of Travis, Fossler, Strother and Henrikson to disclose any constant or meaningful relationship between either the frequency of the breathing anomaly or its temporal course and the overt spasm is

no longer puzzling. If breathing abnormalities appear as conditioned responses to a nonsense syllable, then it would seem that they could easily be conditioned responses to the symbols of speech. In the conditioned response the factor of anticipation is of utmost importance. Yet in the approaches made by the investigators named, the factor of anticipation could not be considered. It was impossible to know upon what word anticipation of stuttering occurred except by a subjective report which under the circumstances would have been highly unreliable. Consequently, the seemingly chance appearance of the anomalies defied explanation. Still the appearance of asynergic movements which had no orderly or explainable relation to the overt spasm may have had a very orderly and logical relation to conditioning factors which were within the situation, but which had not been brought under observation.

Furthermore, if the postulate that the breathing disturbances are conditioned reactions is accepted, the complexity of a situation, with all the possibilities of external and internal inhibition, and disinhibition, might clearly account for the wide variety of relationships between the breathing and speech disturbances during stuttering. The experiments of Pavlov (12) clearly demonstrate this.

Since it is generally held that the "tics," grimaces, and contortive movements of stutterers are conditioned reactions and not essential parts of the stuttering spasm, it seems reasonable in the light of the present findings to conclude that the breathing disturbances, likeside, are conditioned responses.

The records of the conditioned anomalies show one thing quite clearly: asynergic breathing movements are not the result of irradiation of inhibition. In the AC speaking records of three normal speakers, hurried responses with no sign of stuttering or inhibition of any kind were accompanied by marked breathing abnormalities. If irradiation of inhibition had been a true cause of the asynergies, then these disturbances could not have occurred. It seems, therefore, that Bluemel's postulate is clearly without basis in experimental fact.

V. Summary. An analysis of the records of a speech response made with a nonsense symbol before and after it had been conditioned through presentation with an electric shock, and an analysis of the records of breathing movements obtained while *S*s both listened to and spoke the nonsense symbol before and after it had been conditioned revealed the following facts:

1. For both stutterers and normals a speech symbol which was unpleasantly conditioned during a listening period was still unpleasantly conditioned when used in a speech response. Although it was never associated with the unconditioned stimulus when used in speech, 82.2 per cent of the normal speakers and 83.3 per cent of the stutterers experienced anticipation and dread while speaking it.

2. The conditioned symbol hastened rather than inhibited the speech response in 41 per cent of the stutterers and in 29 per cent of the normal speakers. It inhibited the speech response in six per cent

of the normals and in none of the stutterers. In the cases not accounted for in the percentages given, it had no certain effect.

3. Stutterers were not differentiated from normals by any one of the following measures:

a. The mean average amplitude of inspiration, expiration, and irregularity of inspiration level, and the mean average duration of inspiration and expiration both before and after a symbol had been conditioned, and both while the *S*s listened to the symbol and while they spoke it.
b. The mean coefficients of variation of the measures named above and under the conditions described.
c. Correlations between increases in variability of the five measures of respiration during the period of listening to the conditioned stimulus and increases in variability of the same measures during the period of speaking it.
d. Correlations between increases in error in reproducing a time interval and increases invariability of respiration following the conditioning of a stimulus.
e. Correlations between error in reproducing a time interval and variability in respiration.
f. Increases or decreases in the mean time interval of a response with a conditioned symbol.
g. Increases or decreases in the mean error of response with a conditioned symbol.
h. Correlations between decrease in time of response and increase in error.

4. Breathing anomalies appeared as conditioned responses in the records of 11 normal speakers (21.1 per cent of the breathing curves), and five stutterers (11 per cent of the breathing curves).

5. Breathing abnormalities occurred simultaneously with the hurried speech responses of three normal speakers.

6. Conditioned asynergic breathing movements could not be established in four normal speakers.

VI. Conclusions. From the above facts the following conclusions seem justified:

1. So far as this investigation goes, there is no basis for Bluemel's theory that stuttering is caused by a conflict between the conditioned speech reflex and inhibition of that reflex, nor for his theory that asynergic movements of the breathing mechanism are the result of the irradiation of inhibition. In fact, asynergic movements occur very markedly during hurried speech responses of normal speakers.

2. The failure of careful investigators to find an orderly relationship between breathing abnormalities and the stuttering spasm may be explained on the basis that the former are conditioned reactions to the spasm or to the speech symbols on which the spasm or anticipation of it occurs. Consequently, the abnormalities may have no more consistent relation to the spasm than do the grimaces and contortive movements which are generally considered to be reactions to the stuttering.

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REVIEWS

(*Continued from page* 140)

DENTAL HISTOLOGY AND COMPARATIVE DENTAL ANATOMY. By R. KRONFIELD. Philadelphia: Lea & Febiger, pp. 195, 1937, $3.75.

In addition to the material on the anatomy of the several dental structures, the speech therapist will find interesting the considerations on the changes with age of the several structures, the material on the alveolar bone, the physiological influences, the various stages of tooth development and the formation of the several structures, the description of diciduous teeth and their relation to permanent teeth, and will find especial interest in the comparative studies which show how tooth and jaw structures are adapted to the living conditions of zoological life. The book is so simply written that it can easily be understood and be valuable to all. 105 engravings and 10 plates.

THE NORMAL ENCEPHALOGRAM. By L. M. DAVIDOFF and C. G. DYKE. Philadelphia: Lea & Febiger, pp. 224, 1937, $5.50.

To us who work with the living but tend to study only postmortem this book gives a valuable approach to the structure of the living normal brain. After a chapter telling how roent-genological encephalograms are made, the authors, who are well qualified by wide experience, tell of their conclusions and review the literature on: *The Ventricals, Interventricular Foramina, and Aqueduct of Sylvius; The Cerebral Convolutions and Sulci; The Subarachnoid Cisterns and Their Contents;* and *Intercranial Structures and Their Related Fluid Spaces.* This is a newer approach to neural anatomy that deserves careful attention. Indexed, extensive bibliography, 149 engravings. (Chapters IV–VIII). Though we call what the casual breakdown tells us of his feelings (*data*), and our tentative conclusions based on the material (*findings*), none of this has the precision that these two words usually connote. The data and the findings that we offer are in reality *hunch material* which only suggest hypotheses which then demand rigorous testing by other methods. Chapters IX–XVII trace the implications of our hypothesis for each of a number of sectors of the environment, and in Chapter XVIII we attempt to bring the whole into focus in terms of education for life."

HISTORY OF THE HUMAN TEETH. By C. S. SIMPKINS. Philadelphia: P. Blakiston's Son and Company, pp. 329, 1937, $4.00.

In a detailed and interesting manner, Simpkins fills in part of the gap in the speech mechanism omitted by Negus, for phylogenetic phonetics, namely that concerning the teeth and jaws. The *Chapters* indicate his comprehensiveness: *Pisces, Amphibis, Reptilla, Aves, Mammalia, Eutheria, Insectivora, Rodentia, Carnivora, Ungulata, Hyracoidia, Proboscidea, Primates, Anthropoidea, Hominidae, Homo Sapiens, Modern Races of Mankind, Theories of the Origin of Human Dentition.* 111 illustrations, bibliography, glossary, index.

LE NODULE DE LA CORDE VOCALE. By J. TARNEAUD. Paris: Norbert Maloine, pp. 139, 1936, 30 Fr.

Tarneaud has collected together the opinions of other authors and also made a careful study himself of vocal cord nodules. He classes singers nodules and screaming and crying children's nodules as the same defect. In addition to giving us several X-rays, drawings, and an extensive bibliography, his discussion of the nodule is very detailed and progresses with careful logic. He discusses the etiology from the point of view of the forces exercised on the vocal cords during phonation, disordered vibration, and the reactive influence of the cavities. He develops the pathogenesis in Chapter III, and describes the pathological anatomy in Chapter IV. He gives instructions for diagnoses from vocal symptoms and laryngoscopic and laryngostroboscopic examination. Under treatment he outlines the medical, the surgical, the varying procedures for the different clinical forms, and shows what vocal exercises should be used. He concludes with remarks on prevention.

IF YOU STUTTER. By J. MICHAEL. *Consumers Digest*, 1:52–59 (June) 1937.

This article discusses the various places a spasmophemoid "consumer" can go for treatment and what aid he can expect. "The American Speech Correction Association has been instrumental in raising the standard of ethics in the field. A majority of the best speech correctionists are members or fellows of this association and such membership can be taken as presumptive evidence in favor of any worker, although some incompetent persons are also members. . . . There is no consultant to whom a stutterer might go with greater confidence than to a speech clinic connected with an educational institution. . . . The following institutions have had speech clinics established long enough for the quality of their work to be judged. Those recommended have teacher-training courses, have adequate clinical facilities and personnel, and have had reasonable success in dealing with stuttering. Listings are based only on effectiveness in treatment of stuttering, other speech defects not being considered. Some of those given a *Qualified Recommendation* specialize in some type of defect other than stuttering." It is interesting to note that of the 25 speech clinics recommended or given a qualified recommendation, 15 are directed by Iowa State University people, some of the others are practically unknown in the field, and other very outstanding ones are unmentioned. The list follows:

RECOMMENDED

Fort Hays State Teachers College, Hays, Kansas.
Northwestern University, Evanston, Illinois.
State University of Iowa, Iowa City, Iowa.
University of California, Berkeley, California.
University of Minnesota, Minneapolis, Minnesota.

QUALIFIED RECOMMENDATION

Birmingham-Southern College, Birmingham, Alabama.
Brigham Young University, Provo, Utah.
Columbia University, New York, New York.
Iowa State College, Ames, Iowa.
Kent State University, Kent, Ohio.
Kenyon College, Gambier, Ohio.
Montana State University, Missoula, Montana.
Ohio State University, Columbus, Ohio.
Pennsylvania State College, State College, Pennsylvania.
Purdue University, La Fayette, Indiana.
Syracuse University, Syracuse, New York.
Tulane University, New Orleans, Louisiana.
University of Denver, Denver, Colorado.
University of Michigan, Ann Arbor, Michigan.
University of Missouri, Columbia, Missouri.
University of Southern California, Los Angeles, California.
University of Washington, Seattle, Washington.
University of Wichita, Wichita, Kansas.
University of Wisconsin, Madison, Wisconsin.
Western State Teachers College, Kalamazoo, Michigan.

VOICE AND ARTICULATION DRILLBOOK. By GRANT FAIRBANKS (State University of Iowa). Iowa City: Athens Press, pp. 118, 1937.

Several drillbooks have been written by Easterners but here is one for the ninety million "General Americans." The book gives "Diagnostic Forms, phonetic transcription, 27 vowel drills, 32 diphthong drills, 82 consonant drills, 13 consonant blend drills, 28 breathing drills, 91 voice quality drills, 58 time drills, 45 loudness drills, and 65 pitch drills. The book is divided into two parts: *Part I, Speech Sound Production,* and *Part II, Voice Production.* The book is based on more experimental evidence than most drill books and should find application in many more speech classes than those given at Iowa.

CLINICAL PSYCHOLOGY. By C. M. LOUTIT. New York: Harper & Bros., Pub., pp. 695, 1930, $3.50.

Every phoniatrist should have this undoubtedly the best book on clinical psychology on his desk for ready reference. In any event he will want to read the carefully written chapter on *Speech Defects.* The other chapters are on diagnostic methods, feeblemindedness, *School Retardation, Specific Disabilities in School Subjects, Superiority, Behavior Problems, Conduct Problems, Juvenile Delinquency, Personality Problems, Psychoneuroses and Psychoses, Sensory Defects,* and *Neurological and Physical Disabilities.* There are 89 tables and 21 figures and also a bibliography of 44 pages of references. The book is quite complete.

A BIBLIOGRAPHY ON READING

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NOTE: Numbers following pages such as, 37-2471, indicate that an abstract of the article appears in the Psychol. Abstracts year 1937, Abstract No. 2471.

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(*To be Continued*)